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PETRALOG

A
TREATISE ON ROCKS,

John
BY J. PINKERTON.

VOL. I.

Robert Troup Paine
to Harvard College.

LONDON.

PRINTED FOR WHITE, COCHRANE & C.º FLEET STREET.
By S. Hamilton & C.º Weybridge.
1811.

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Other objections.

Thus some writers have been contented to divide minerals into Classes, Orders, and Genera; while others, instead of the last, have only Species. Some have Varieties; and Werner, with a truly German want of taste, has added Sub-species and Sub-varieties; while, as the terms are merely arbitrary, he might have chosen far more classical words to express his distinctions.

The cause of this embarrassment, as has often happened in the progress of science, is owing to the pursuit of a routine, of a form, which has become antiquated; while the discoveries being wholly new, a new phraseology was indispensable. Thus in natural history Linnæus having established the received classification in botany and zoology, the same terms were introduced into mineralogy, without the simple reflection that the subjects were wholly distinct: for the terms, indicating animal and vegetable life, could not without manifest absurdity be applied to dead and inert matter. The consequence was, that as the terms conveyed no idea they were used indifferently, and what was *Class* with one author became Order with another; while the Genus of a third, as has been already mentioned, became the *Species* of a fourth: and a few of deeper sagacity began at last to doubt the propriety of one or other of these appellations.

In fact the terms class, order, genus, and species, convey real and vivid ideas of life. We say a class or an order of men, a genus or species of animals, with complete perspicuity and propriety. Nor is the transition to plants in the least violent, as the word species in particular may be here used with some classical authority. But when applied to minerals they become wholly arbitrary, and convey none of these substantial ideas which belong to real knowledge, and which the mind grasps, so to speak, as solid and tangible: for as the characteristics are here of a totally different kind from those of animal or vegetable life, they should be distinguished by new and appropriate appellations. As we shall never describe an animal from its texture, fracture, or other distinctions of minerals, so it is equally absurd to describe these by attriinadequate to the subject, to carry this species of metaphor too far, some lesser divisions must be borrowed from the nature of the objects, as they present themselves to the observer.

Grand provinces. I would propose, therefore, in the present advanced state of the science, that the mineral kingdom be considered as divided into three provinces: 1. Petralogy, or the knowledge of rocks, or stones which occur in large masses. 2. Lithology, the knowledge of gems and small stones. 3. Metallogy, or the knowledge of metals. Each of these branches is even at present so important, and offers such numerous topics of disquisition and research, that in the course of no long period a professor of each will appear in universities; and each might occupy the sole pursuit of an author who is zealous to make discoveries, or to compose complete and classical works. One of the chief causes of the slow progress of the science is, that it is too wide for one mind; and as zoology has been divided into ornithology, ichthyology, entomology, &c. so mineralogy, to be duly studied, should have grand subdivisions.

Domains. These provinces may again be viewed as divided into Domains, corresponding with the Orders of some writers and the Genera of others, as the Provinces supply what are called Classes. This term Domain is preferred to District, &c. as it not only implies a subdivision of a province, but, in another acceptation, a ruling or preponderating power, strictly applicable in mineralogy, where it is often the preponderance, and not the universality, which imparts the denomination. Thus in the siliceous, calcareous, and other domains, it is only understood that the denominating portion preponderates, as few or no rocks are pure, and unmixed with other substances.

Petralogy, a province of mineralogy, may therefore be regarded as divided into Twelve Domains; of which the first six, being distinguished by the substances themselves, may

Substantial. be called substantial: while the remaining six, being distinguished by circumstances or accidences of various kinds, may their arbitrary and unnatural systems, as Dr. Townson has observed, the Genera and Species are often confounded. "Thus in the improved edition of Linnæus, the characters which constitute the *Species* in gypsum form *Genera* in the carbonate of lime; for the pulverulent, fibrous, spathous, and compact kinds of gypsum form but so many *Species*, whilst the pulverulent, fibrous, spathous, and compact kinds of carbonate of lime form so many different *Genera*."[*] Now these very appearances, which constitute the arbitrary Species and Genera of former authors, what would they be, in the eyes of a philosopher or grammarian, except different *modifications*, or *modalities*, of the same substance, and which by a shorter term may be denominated Modes? Hence the term MODE, which is universally applicable and unobjectionable, to distinguish such objects in mineralogy, is here admitted instead of Species[†].

To put the propriety of this new appellation to the test, examples may be produced of what are called Species by the most celebrated mineralogic writers. Wallerius, among the species of garnet, first mentions that of an undetermined figure, composed of granular particles; and his next species is of an undetermined figure, but laminar. What are these but different modifications, or modes, of the same stone? His ripe asbestus, consisting of fibres which may be separated, forms one species; while that of which the fibres cannot be separated constitutes another. What are these but different modifications of the same substance? In the last edition of Linnæus by Gmelin the term *modes (modi)* has been applied to various appearances of petrification: but what are sometimes called Genera, and sometimes Species (as already observed from Dr. Townson), are, in strict language, mere modifications of matter. If we pass to one of the most exact of the French mineralogists, we shall find the sapphire arranged as the tenth species of the siliceous, and the topaz

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[*] Philosophy of Mineralogy, p. 173.

[†] Εἶδος implies *modus*, as well as *species*.

Structures. This, the most important part of the arrangement, being thus borrowed from chemistry, which, like a guardian angel, should always hover round and direct the labours of mineralogy; the other subdivisions only require a characteristic clearness to assist the memory (the chief object in any system of natural history), and an appropriation to the subject, so as to satisfy the judgement and imagination. From the earliest productions of Linnæus to the present time, the word STRUCTURE has been applied, with classical propriety, to denote a most striking and characteristic distinction between mineral substances, whether on a great or on a small scale. Linnæus has observed that there are only three great roads which can conduct the curious traveller through the mineral kingdom; that of Physics, or Natural Philosophy, which treats of the obscure generation of stones; that of Natural History, which examines their evident structures; and that of Chemistry, which considers their analyses[*]. A term thus strictly appropriated, and, as it were, consecrated to the science, has therefore been selected for the next characteristic subdivision.

Aspects. But as Werner and his disciples not only admit the various earths as so many Genera; and their Modes, or the modifications of the mixtures, and even colours, as so many Species; but also what are, with great penury and uncouthness nation of this paragraph. When we wish to arrange a system; or, which is the same thing, when we wish to determine the natural order of bodies, we must first find a principle on which to ground that determination. But this principle should be taken from the nature of the bodies, as being the consequence of it; and since it is by that we determine in what degree these bodies are similar or unlike, it should show equally the principle of their difference. We perceive in these bodies certain resemblances which are the foundation of their differences, and as these several resemblances are more or less allied or varied, so it is with the bodies which produce them; this then is the only principle on which we can determine the class or order of these natural bodies. It remains now to show where relations are found in natural bodies; but here we find a difference between them, for they are divided into two principal species, these relations in one consisting in the conformation, and those of the other in the composition. The first comprising animals and vegetables, as the second embraces meteors and the mineral kingdom. It is true that, as being natural bodies, they are at the same time aggregated and composed; but the first are formed of parts differing one from another, and which we call *organs*, which constitute their relations; the last, on the contrary, are simple, or formed of similar parts, and consequently can have no relationship in their aggregation. Now, as they nevertheless really differ, that is to say they have different characters, we must endeavour to recover them in some manner; and, as I have already said, this can be only by their composition. As a proof of which, when I have divided into as small parts as possible, a substance of one of the first two kingdoms, for example a plant, I cannot affirm that each separate part is the same plant; because not any of these parts have the same relationship as in their state of aggregation, that is to say in their entire plant, and that it is this total which forms this or that plant. It is then in this reunion that we must show the character of this plant, since it is destroyed by the division. On the contrary, I can divide aggregation, while in the latter it follows their composition.

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[*] "Via triplex tantum per Regnum Lapideum curiosos ducit: Physica quæ descendit per Lapidum obscuras *Geneses*. Naturalis quæ excurrit per Lapidum apricas *Structuras*. Chemica quæ adscendit per Lapidum destructivas *Analyses*." Linn. Min. à Gmelin, p. 14.

In the edition of his System, Holmiæ 1768, Linnæus has the following among the external characters: "The Structure, foliated, fissile, convergent, in fragments." Werner says limestone is of a simple structure. Dr. Thomson, in his valuable Chemistry, says that gneiss differs in its structure from granite; and that the structure of mica slate is thinly schistose. It is chiefly judged by the fracture; and is as applicable to small specimens, if well chosen, as to the rocks themselves: it may be earthy, compact, columnar, large-grained, &c. &c. In classical Latin *structura* is not only applied to the largest edifices, but in very minute senses, as *structura versuum*, *structura verborum*.

"But the following question may still be raised concerning the order and system of minerals: 'As it is certain that minerals, when their composition changes, are also changed in their exterior, cannot we in this exterior find characters to determine their natural order or sequence, as well as those that are taken from their affinities of composition?' Here is the answer: We can, it is true, discover the different relations of composition in minerals by their different external characters, when they are both determined beforehand; but we cannot discover the order of these conformities, because nature employs indifferently sometimes one character, sometimes another, to indicate the interior difference, that is to say, the composition; in the second place, because each exterior character sometimes arises from an essential difference, at other times only from an accidental variety. The systems of those who have inclined to arrange minerals by their external characters, may already furnish proof of the inconveniences of this method, because we there see minerals brought together which are essentially different; and that those of the same kind are separated by reason of some accidental variety. Botanists and Zoologists have this advantage, that in the objects of those sciences they find the conformities of bodies by their exterior; and that while they endeavour to class them, according to the aggregation of their external parts (or organs), they describe also their external characters, and in some measure accomplish these two objects at the same time. The labour of mineralogists is quite different; they must determine at once the composition of minerals by their appearances under chemical operations, or otherwise leave it to be determined by the chemists, and consequently class them accordingly. They ought, on the other hand, to seek after their exterior characters, in order to complete the description from them.

"I shall also remark, in the first place, that mineralogists hitherto seem to me to have been too much attached to the on rhetoric and logic. The great Milton, in his Latin treatise on logic[*], has discussed this subject, chiefly on the authority of Aristotle and Cicero: his examples are only accidentally from living beings; and he even appears embarrassed to distinguish between the species and individuals; for he argues that, as form is admitted by Aristotle as a discrimination of the species, and every man differs in form from another, so every man must form a distinct species. He adds, that the lawyers allow *man* to be a genus, while *individuals* constitute the species; but he observes, that Ovid divides the *genus* ANIMAL into *five species: Stars, Birds, Beasts, Fishes,* and *Men.* So Cicero divides *virtue* into four *species*: Prudence, Justice, Fortitude, and Temperance. The pedantry of this great poet is truly risible; but thus it was when logic was the art of talking nonsense according to a fixed method. Yet it is from logic, as Werner and the other German mineralogists allow, that the imaginary distinctions of genus and species were admitted into mineralogy!

Dolomieu being sensible that the whole process depended upon ascertaining the *species*, which if once admitted, the *genera*, &c. would follow of course, has employed much metaphysical reasoning in his usual prolix, confused, and digressive style, to ascertain an imaginary species in mineralogy. He ought to have begun by informing his readers, that he was only discussing the word species, *as used in modern natural history*, where, in that of animated nature, it has become a useful distinction. But the ancient and classical senses may be learned from the commonest dictionaries[†].

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[*] London, 1672, 12mo. cap. 27.

[†] As for example that of Ainsworth. "SPECIES, ei. f. (à SPECIO.) (1.) A form, figure, fashion, or shape. (2.) A sight, or object presented to the sight. (3.) A likeness, or representation. (4.) An outward show, or appearance. (5.) Colour or pretence. (6.) A vision or sight, a spectre. (7.) An image, picture, or statue. (8.) An example, a specimen or instance. (9.) The quality or nature of a thing. (10.) Also a particular sort, a kind of things under a general head. (11.) Sight or view. (12.) All kinds of spice, a drug. (13.) Corn or fruit. (14.) A piece of money. (15.) A garment, or apparel. (16.)

As it is therefore granted on all hands, that chemistry alone can decide what is called the species, and that it depends chiefly on the MODE OF COMBINATION, is it not more logical and philosophical to adopt the only term which can express its real nature?

It is clear that Haüy has abandoned his doctrine of species, in which he had followed Dolomieu, who assumed the *molecule integrante* of Delisle as the basis of a species*. Dolomieu closes his elaborate essay on the subject with the following strange definition of a species, in fact a mere *ens rationis* in mineralogy.

Dolomieu's species.

"The mineralogic species is a being distinct fro a
others by a particular constitution, and which rece :
that constitution every thing which should cha it.
This being exists in the integrant molecule, is ph ly re-
presented by the homogenous masses which have b-
mitted to the laws of regular aggregation, and it l
its dependence all the beings which have a similar co i
tion, even when faults of conformation set them at a dis e
from the physical representation of the species, or v
superfluities and contaminations make it wear a t
livery." A very curious and original specimen of a
tion!

Though Werner repeatedly allows that all mineralc arrangements must depend upon chemistry, as they can only be formed on the quality, and quantity, and mode of combination of the constituent parts; yet, with a not illaudable predilection in favour of natural characters, he uses them chiefly to decide the species; while the species is in fact the most important and the most dependent upon chemical

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retire constamment les mêmes principes, est une espèce. Il n'est pas necessaire de savoir si elle a une molècule. Mais l'analyse seule est insuffisante, il faut encore avoir ègard aux caracteres exterieurs, et aux propriétés physiques; comme pour le spatte calcaire et l'arragonite, le ruthil et l'oisanite. *Journ. de Ph. Juillet*, 1809.

* See Tableau, p. ii. "J'ai préféré l'indication de *la forme primitive* a celle *de la molécule integrante*," &c.

aid*. Hence have arisen the chief errors in his system, ably exposed by Chenevix, who has shown that the different species of Werner are often vague and indeterminate; and the order of his arrangement not seldom capricious and imaginary, and far from being founded on his own principle of chemical composition. The calcareous spars are united under several *groups*, according to the acid which predominates. Those he has marked A, B, C, D, are truly German distinctions. Dr. Thomson has justly observed, that by his use of *groups* and *families*, Werner is struggling against his own system.

But the *mode* admitted in the place of the *species*, obviates these difficulties. It presents a real chief distinction between the species, that founded on chemical analysis, as it refers to the *mode of combination*, the ruling principle in the difference between one mineral and another, considered even in the most abstracted point of view, and with regard to the purest substances, as crystals, gems, &c.; as even a variation in the water of crystallisation sometimes distinguishes one mode from another. But though what are admitted as distinct modes, will perhaps always be found to differ in chemical analysis; yet as the science does not admit of too much precision, while the substances themselves are always variable, as partaking of a mutual nature, and only portions of that vast mixture the shell of the globe; the mode may also more laxly be understood to include some modifications of external characters, under what is called aggregation in particular. Thus the aggregated stones may become modes, as well as the combined. But in passing to the Structure and Aspect, the chemical characteristics may in general be considered as abandoned, or exchanged for the physical or external.

This unavoidable uncertainty has been well illustrated by the greatest of petralogists.

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* Bergman, the father of the system, derives the species from chemistry. See also Brochant, i. 47. Jameson, i. xxv.

Saussure's observations.

"One cannot too often repeat that there must be found in the mineral world, and that in effect in it are found, all the mixtures in all imaginable proportions, from which proceed an infinite number of mixed and undetermined kinds.

"If in the kingdom of organised beings, where the specific forms are determined by the seeds, it is often difficult to mark the limits of the species; how much more so to ascertain them in one where only the force of cohesion unites the elements, whatever be their nature, and in whatever proportion chance collects them.

"It is for this reason that in this wo[illegible] I have a[illegible] giving names to the stones I have written [illegible] not been able to ascertain them by deci[illegible] could fix their place in the known system of [illegible] clature.

"Those who collect and the no[illegible] called, do not like these doubtful sorts, [illegible]ich it is t[illegible] cult to arrange under the known genera. [illegible] even reject them entirely, because they a[illegible]re the imperfection of their systems. For t[illegible] in the greatest number of cabinets, only the [illegible] wh[illegible] racters are decidedly known. There nothi[illegible] is conformable to received systems, and all [illegible]ixed But when nature is studied by herself, when one [illegible] instead of finding cabinet specimens, to st[illegible]ly [illegible] the productions of the mineral kingdom, and is at the time jealous of a certain degree of precision, o[illegible] fin[illegible]t every step individuals which it may be said to be imp[illegible]le arrange under known denominations. One may [illegible]rk the bounds; one may determine how far each indi[illegible] proaches to, or recedes from, such and such a species; [illegible] one cannot positively affirm the name of the one or o[illegible] of these species."*

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* Saussure, ii. 606.

§ 2. *Order of the distinctive Characters.*

The present work may be said to have passed through several editions, before its public appearance; and the portions newly modified, or finally rejected, with the detached discussions, composed in order to consolidate the progress and universal consistency of the plan, would form a moderate volume. These precautions became necessary, as upon an unknown coast the discoverer employs boats to sound the bottom, before the ship can advance with safety. Among numerous difficulties, which will be perceived in proportion to the learning of the reader, the arrangement of the characters, and the choice of one or two of the new terms, were not the least. They now stand as follow: Texture, Hardness, Fracture, Fragments, Weight, Lustre, Transparency; to which the colour is sometimes added, though the most vague and insignificant of all the characteristics.

Order proposed.

Murray, in his excellent System of Chemistry, has justly observed that it is difficult to attach precise ideas to arbitrary numbers. Every reader must have observed, that he passes without reflection the ciphers 1, 2, 3, &c. when applied to Hardness, Specific Gravity, Lustre, or Transparency. It therefore seemed more advantageous to employ terms derived from the substances themselves, which, though only relative and recollective, yet convey ideas more clear, and, so to speak, more tangible than barren ciphers. In this, and other instances, the reader not conversant with modern mineralogy may perhaps be surprised at the neology: but he must be informed that the science itself is entirely new; and that there is no recent mineralogical work which does not abound with new terms, not to be found in any dictionary, but which are indispensably necessary, in order to delineate substances and qualities which did not before fall within the range of human intellect or language. The names which have been added to botany and zoology, within half a century, might be

Objections to ciphers.

Neology indispensable.

counted by hundreds; and in the progr [illegible] of m [illegible], a similar neology cannot be avoided. [illegible] ile [illegible] it authors of mineralogy pollute the [illegible] o fathers with an inundation of barb [illegible] rived from the vulgar dialects of illit [illegible] te miners, [illegible] o course first observed the distinctions b [illegible] veen mi [illegible] l it became the more an object of ambiti [illegible] to treat [illegible] cult subject with such a degree of [illegible] purity, [illegible] to disgust the eye of taste, contemn t [illegible] ons or mar, or vitiate the eternal tenor of our [illegible].

New terms. The new terms chiefly required, [illegible] degrees of hardness and weight, which h [illegible] be [illegible] i ciphers, even by authors who used epithets to [illegible] other characters. As Chalk, Gypsum, Marble, [illegible], I spar, Rock Crystal, and Corundon, form vario [illegible] of hardness, at the distance of 200 or more in the tables, they have been chosen to express the relative **Hardness.** of other substances, by the following terms, *Cre* [illegible], *Marmoric, Basaltic, Felsparic, Crystalic, Corundic,* to diversify the form of the epithets, the weight [illegible] b designated by another Latin adjective termination, [illegible] *osus*, which some grammarians affirm generally [illegible] ote weight or labour, as *laboriosus, ponderosus,* [illegible], [illegible] the last word has even been admitted into class [illegible] in the form *operose*. As Pumice, [illegible] Gran [illegible] and Barytes, form a [illegible] gr [illegible] o [illegible] in v [illegible], th [illegible] **Weight.** here selected to denote [illegible] y, [illegible] ose, [illegible] *bonose, Granitose, Si* [illegible] *yt* [illegible]

But the characters [illegible] elves, and their arrangement, require further explanations. The Texture and Hardness occupy the first place, because adepts generally examine them first, by means of the lens and knife. Dr. Townson has observed that these instruments should always be in the pocket of a mineralogist. "With the latter, after a little practice, he will be able readily to find the hardness of most fossils; and the former will furnish him with very accurate knowledge of their texture, and be of particular use in many of his geological speculations on their formations."*

Townson's difficulties.

Werner's incongruities.

This skilful author has arranged his characters in the following order: Texture, Fracture, Lustre, Hardness, Fragility, Transparency, Fragments, Colour. It is hoped the present arrangement will be found more justly progressive and connected. But after having advanced several cogent arguments against Werner's arrangement, in his tenth chapter, which treats of Classification, Description, and Investigation, he strangely introduces the following remark in his ninth chapter, on the Exterior Characters of Minerals, which hence appears to have been written after the tenth. "Though I have made some objections, in my tenth chapter, to the order of the characters in the descriptions, disapproving of their beginning by their least characteristic qualities, as colour and accidental shapes; yet I perceive, were I to throw these further backward, other inconveniences would be the consequence. The characters belonging to each of the three different states of cohesion, as solid, friable, and fluid, are placed under their respective heads; but the colours, being common to all the three, are placed first." This is certainly a specimen of careless composition. The supposed inconveniences ought to have been indicated, if they did not consist in the *labour, certainly* not small, of altering or rewriting a system already composed, in order to render it coherent and uniform. But the forcible arguments, in his tenth chapter, remain unconfuted; and the arrangement of Werner's characters have met with other able opponents. His extreme attachment to the distinction of colours, from which he has even deduced many improper, not to say absurd, appellations of mineral substances, has led him to place this vague characteristic in the first rank. The incongruity of the concatenation has been justly ridiculed in other respects. From the Lustre [illegible] passes to the Fracture, and from the Fracture to the Transparency; from the Coldness to the Weight, and from the Weight to the Smell. It would certainly have been more natural and rational to have joined the Lustre with the Colour, and the Weight with the Hardness. His idea of the successive use of the senses, in the examination of any mineral, is quite imaginary; as before an examination with a lens, it may be weighed in the hand, or its hardness tried with a knife, &c.; and it would be ridiculous to build a science upon simple exertions of the will. Independently of this new kind of pedantry, derived from German metaphysics, it is not the consideration what senses are first impressed, that should regulate the succession of characteristics; but, on the contrary, their own intrinsic importance. Hence the TEXTURE is here placed in the first rank, though totally omitted by Werner, or confounded with the fracture, with which indeed it is intimately allied: but two other celebrated mineralogists, Wiedemman and Estner, have justly introduced the texture as a characteristic of the most radical importance. In many cases it may be judged by the eye, but in most requires a lens. The hardness, which follows, may be tried by the knife or file; instruments indispensable to the mineralogist. The weight may, after some experience, be estimated by the hand; but some of the disciples of Werner have confounded this external character with the specific gravity, which belongs to the chemical class of characters.

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* Philosophy of Mineralogy, London, 1798, 8vo. p. 187.

Mr. Kirwan has justly observed the inaccuracy of Werner and his disciples, who have confounded the texture with the fracture. The most minute account of the former, is that by Dr. Townson above mentioned.

Townson on the texture.

"*The Texture, Textura,*

"Is the internal structure or disposition of the matter of which a mineral is composed*.

---

* "Mr. Werner says nothing on the texture of minerals; but under the article of fracture, gives many characters which belong not to the fracture but to the texture; so that the characters of texture and fracture, though very d
are united under one head and confounded together. But in the w

Compact *Compacta* *Dicht*	Without any distinguishable parts, or the appearance of being composed of smaller parts. Examples, Chalcedony, Flint, &c.
Earthy *Terrea* *Erdig*	When composed of very minute, almost invisible, rough parts, as clay, marl, &c.
Granular *Granulata* *Kornig*	When composed of small shapeless grains, as granulated quartz, sandstone, &c.
Globuliform *Globuliformis*	When composed of small spherical bodies, as the pisolithus and oolithus.
Fibrous *Fibrosa* *Faserig*	When composed of fibres. Examples, Fibrous gypsum and amianthus. The fibres may be

Fine	*Tenuibus*	Parallel	*Parallelis*
Coarse	*Crassis*	Divergent	*Divergentibus*
Long	*Longis*	Stellated	*Stellatis*
Short	*Brevibus*	Fasciculated	*Fasciculatis*
Straight	*Rectis*	Decussated	*Decussatis.*
Crooked	*Curvatis*		

Radiated *Radiata*	When composed of long, narrow, flattish lamellæ. This differs from the fibrous by the parts being broader. Examples, grey antimony, manganese, zeolite, actynolite, &c. This admits of the same variations as the preceding.
Lamellar *Lamellosa*	When composed of smooth continued leaves or plates, covering one another. Example, as the spars. They may be

Straight, *Rectis*, as in most spars; or
Crooked, *Curvatis*, as in Schiefer spar; or
Spherical, *Sphæricis*, as the mica [illegible] sphærica;
Undulating, *Undulatis*, as in talc; . . . . .

Messrs. Wiedenman and Estner, there is an article under which several characters of the texture are given. Some of these I have arranged under this [illegible]; others, under that of structure or compound texture. In Mr. Werner's [illegible] work on the outward characters, this article does not exist."

Slaty *Schistosa*	Composed of thin layers or beds, as As the preceding was more pecul[illegible] t[illegible] crystallised, so is this to the rupe[illegible] ic[illegible] sils. As this is rather a character of st[illegible]c- ture than texture, probably it might be omitted [illegible]
Scaly *Squamosa*	Composed of a congeries of small scales. Peculiar to the plumbago, according to Estner.
Sparry *Spathosa*	Composed of a congeries of irregular crystalline parts, like coarse salt, as the coarser kinds of scaly or saline limestone, as that of Sala in Sweden, some hornblende-schistus. This belongs to the granulated of the Wernerian school.

" In judging of the texture, attention must be paid, when it is not of the compact kind, but of the fibrous or lamellar, that it is inspected in a proper direction, which is that of its parts; otherwise, when in the opposite direction, the fibrous may appear granulated, and the lamellar radiated."

Dr. Townson says that the structure is a particular disposition of the texture, as Hornblende-slate may have a sparry texture and schistose structure; some iron ores, an earthy texture and columnar structure. Of the Structure he only indicates four kinds:

Slaty, Testaceous, Concentric, Columnar.

The first is too general, the three others too rare, to be of real utility in a general system; and this confined use of the word Structure would interfere with its general use in other senses equally appropriate.

Hardness. The HARDNESS, another grand characteristic, may be best illustrated in Werner's own words, which will at the same time serve to convey some practical admonitions to the student.

Werner's account. " After the particular generical characters discovered by the sight in solid fossils, follow those which may be observed by the feel, the first of which is hardness, forming the tenth in the general system.

"Upon handling different fossils, we soon perceive (to use a familiar expression) that some are softer than others. For instance, a piece of gypsum is much softer to the feel than a piece of quartz. This difference is better observed when we make use of some instrument fit for the purpose*. This is what is termed by mineralogists the investigation of hardness; and, with respect to this property, we shall divide solid fossils into *hard*, *semi-hard*, *soft*, and *very soft*.

"A fossil is called *hard* which cannot be marked or scratched by the knife, or rather which emits sparks, being struck by the steel. This degree of hardness is to be found only in fossils which are perfectly brittle *(Sprode)*. Hard fossils are also distinguished into those *which are affected by the file*; those *which are but in a small degree*; and those *which are not in the least*. To the last belong the diamond, ruby, and emerald; in the second may be placed the topaz, rock-crystal, amethyst, flint, chalcedony, carnelian, &c. which yield a little to the file; among those on which the file takes effect, are white copper-ore, micaceous iron-ore, hematite, most compact iron stones, red and brown tin crystals, most shining grey cobalt ores *(speis kobolt)*, arsenical and sulphureous pyrites, &c.

"*Semi-hard* is applied to a solid fossil which does not emit fire with steel, and which may be marked or scratched by the knife. Of this nature are *fahlers*, red copper-ore, sparry iron-ore, hard earthy lead-ore, most blendes, white [illegible] cobalt-ore, native arsenic, kupfernikel, limestone, mo[illegible] vitreous spars and guhrs, fluor spar, zeolite, basalt, and others.

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* "The instruments employed by mineralogists in this investigation are, the *knife* for semi-hard and soft fossils, the *steel* for those which are hard, and the *file* for fossils perfectly hard. The knife may also be used to judge of the streak and ductility. In order to possess a complete mineralogical apparatus, it will suffice to add to these instruments a *magnifier*, which will often be wanted to determine the exterior form and fracture, and which may be well observed with a single glass; 2. a *small phial* of *aqua fortis*, the use of which I shall disclose in the last chapter; 3. a *loadstone*, which for convenience may be so managed as to serve at the same time for a steel. If there be also added a blowpipe, in order to make essays speedily upon minerals with the assistance of fire, we shall possess all to be desired. These articles may all be met with, well made and adapted, at Mr. Schubert's, Mechanic to the Academy of Mines, Freyberg."

" *Soft* solid fossils are those which are easily affected by the knife, but receive no impression from the finger-nail. Such are white silver-ore, vitreous silver-ore, [illegible] red silver-ores, vitreous copper-ore, mountain blue-ore [illegible]pper, most bog iron-ores *(Rasen eisenstein)*, galena, com[illegible] lead-ore *(bleyschweif)*, white and green lead-ore, red ph[illegible] (from Scharfenberg near Meissen), amber, hea[illegible]s *(Stangen spat)*, mica, asbestos, serpentine, &c. &c.

" *Very soft* is applied to all solid fossils whi[illegible] not marked by the knife, but upon which the finger [illegible] an impression. Of this kind are most solid cinnab[illegible] neated metals, or native metallic muriats, micaceous b[illegible] ore, grey ore of antimony, most earthy cobalt-ores, co[illegible] flowers, oxyd of native arsenic, realgar, native sulphur, [illegible]neral pitch, most pit-coal, plaster-stone, *glacies mariæ*, [illegible], black lead, most kinds of manganese, steatite *(Speck stein)*, amianthus, chalk, &c. &c.

" But these different degrees of hardness are so apt to approach each other, that we find each of them not only of many varieties, but very frequently observe fossils bordering upon two degrees of different hardness, which varying a little from both, forms a medium between these two degrees. For example, hard magnetic iron-stone and opal, have nearly the same hardness with semi-hard kupfernikel and basalt; semi-hard copper pyrites and malachite approach the soft heavy spar and white lead-ore in hardness; soft red silver-ore and amber approach the very soft cinnabar and native sulphur. It becomes therefore a matter of importance to determine the hardness of a fossil, to indicate not the principal degree of hardness alone to which it belongs, but also its relation with known fossils of the same degree, and to observe when a fossil forms a medium between two degrees. Thus, for example, we [illegible] say that *fahlers*, or grey silver-ore, is semi-hard, but softer than copper *fahlers*, and harder than copper pyrites; that amber is soft, and forms a medium between soft and very soft fossils."*

Weight.

Not to mention the FRACTURE, FRAGMENTS, LUSTRE, and TRANSPARENCY, which are described in the common terms of most systems of mineralogy, it may be necessary to add a few words concerning the other remaining characteristic, namely, the WEIGHT. In this, as already mentioned, a relative scale is proposed, instead of ciphers, which seldom supply prompt or immediate ideas, especially as the reader generally forgets the tables prefixed. The total dismission of ciphers serves, at the same time, to render the arrangement more uniform and harmonious. The Weight has been, by many of Werner's disciples, confounded with the Specific Gravity, which requires an operation, and does not belong to the external characters of Werner; while the Weight, with some experience, may be estimated, as he says, by the hand. His epithets, however, are in this instance particularly indistinct, being *Very light, Light, Rather heavy, Heavy, Very heavy*. His scale is also too brief, five degrees being necessary for the gems and rocks, and five more for the metals. For while the specific gravity of platina is about 21, gold 19, silver 10, copper 8, iron about 7, and tin little inferior, *barytes only exceeds* 4; so that there is a wide transition from the heaviest stones to the metals, but not so great to the ores. To the metals, therefore, another scale should be adapted for common use. It is hoped that the one here proposed will be found sufficient for the purposes of petralogy; and it is, like the other improvements, submitted to the discussions and alterations of the intelligent in a science which is quite new and [illegible] progressive.

§ 3. *Remarks on Werner's Geognosy, or System of Rocks.*

From the sketch imparted by Daubuisson to Brochant, and from Mr. Jameson's Geognosy, we are enabled to form an idea of Mr. Werner's system concerning the formation of such parts of this planet, as we can hope to observe, little exceeding the three thousandth part of its semi-diameter. [illegible] warmly subscribe to the sentiments of admiration which are paid to Mr. Werner's superior talents in many branches of mineralogy, a science infinitely indebted to his industry and [illegible]. I also acknowledge the truth of the apophthegm, [illegible] *fecit omnes judices, paucos artifices.* But I regret, with his most enlightened admirers, that the scene of his inquiry has been too confined; and that his views of the mountains of Saxony has not been extended over the globe. After forty years of sedulous observation among the Alps, Saussure, who began his labours with a view of forming a system, declares that his hopes were frustrated; and that he had met with such unaccountable confusion that he could not venture to propose a theory. Yet Saussure, to practical observations on a far superior scene, added the advantages of learning, and mathematical and meteorological science, which Mr. Werner unhappily wants, and which would have corrected and greatly improved his speculations.

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* Werner, Ch. Ext. p. 272.

Saussure's difficulties.

After describing the general appearance of the surface of the earth, and the effects of water, he proceeds to consider the structure of rocks, in their minute parts, and in their general fabric; the latter chiefly consisting of the stratified structure, and that with seams, in which last he includes columnar basalt. His grand doctrine of formations next appears. When the mass is uniform, as in granite, gneiss, limestone, the formation is said to be simple; but when dissimilar masses occur, as of coal and basalt, it is called compound. When the formations consist of several substances always found together, though in regions of different compositions, they are all called independent formations; but when only associated, they are called subordinate. The universal formations are found all over the globe; but partial or anomalous formations are confined to particular spots. Detached portions on the summits of hills are called caps; b when a part appears only on one side of a mountain, it

Formations.

Other terms.

said to form a shield. When the superior strata have the same direction with the fundamental rock, they are said to be conformable with it; but when the direction is different, they are called unconformable. Sometimes they are simply unconformable, as differing only in direction; but when in addition to this they pass over the terminations of the inferior rock, they are said to be unconformable and overlying. Strata may also be strait, form a mantle around the inferior rock, cover its extremities in the shape of a saddle; or, when concave, assume the form of a bason or a trough.

Primitive.

Transitive.

Floetz.

Considering Mr. Jameson's work as notes taken during Mr. Werner's lectures, it may be assumed that this illustrious mineralogist then proceeds to consider the succession of the different formations. Those rocks which are always found inferior, are called Primitive; and have a crystalline appearance, intimating a chemical solution, when the water stood very high over the surface of the earth. The next class is called Transitive; which, though chiefly of chemical composition, exhibits also mechanical sediments and petrifactions. The third class consists of Stratified rocks, styled by Werner *Floetz*, signifying that they are in flat or horizontal *layers* or *beds*; a stratified rock implying that the strata are of one and the same substance; while the *Floetz*, or *rocks in layers*, often present beds of different substances. But this distinction is not of such utility or importance as to necessitate the introduction of a barbarous word; and if *stratified* be not precise, we may use *stratiformed* with Daubuisson. The Alluvial and Volcanic rocks form the last divisions.

Granite.

It is to be regretted that the examples and facts are not sufficiently numerous, but even the primitive rocks seem all to be regarded as stratified, except granite, which is assumed as the universally radical rock. In the Alps, Saussure has observed that the granite presents marks of stratification. Gneiss is also found under primitive granite; and Mont Rosa, nearly equal in height to Mont Blanc, consists chiefly of gneiss and other stratified rocks. After long and diligent inquiry, the position that granite is the universally rock, would appear to be rather an assu[illegible]ound theory, than a fact supported by proofs; for if we ex the accounts of the substances found at the greatest de in coal mines and other excavations, there is no appearance of granite; and if lavas often arise from a vast depth, a f now admitted from the prodigious extent of the precedi earthquakes and other phenomena, the chief substance r mixed with clay; and the mineralogical appearances te confirm the opinion of astronomers and natural philosop that the nucleus of this planet consists of iron, which, even when native, is seldom found unmixed with silex, so t if any rock can be called fundamental, it must consist of a mixture. It is true, that granite itself presents i composition, as iron is found in the mica, and still more the siderite, which in the oldest granites often supp place; and what is chiefly to be regretted, is the v : of positive proofs concerning the anteriority of granite.

Dissolutions and sediments.

Werner proceeds to explain the effects of the gradual and slow diminution of the primeval waters, in producing chemical dissolutions from a great height, and afterwards gradual sediments; so that, according to his theory, the shell of this globe, instead of presenting a ruinous and unaccountable confusion, exhibits, when viewed on a large scale, a regularity and harmony, such as are admired in the other works of the great Creator.

Sequences.

Objections.

Having thus briefly explained this celebrated theory, it must be added that the rocks are divided into various formations, which often receive arbitrary and unexpected epithets. Thus the series called the SLATE FORMATION, is so named from the central member SLATE, rising to mica slate, and passing from gneiss into granite; while, on the other hand, the descent ends in coal, sand, and clay. It must strike every enlightened observer, that such a distribution, instead of leading to a just and accurate knowledge of rocks, as they occur in different parts of the world, would only form an illustration of the Wernerian system; which may, in the progress of discovery, be found, like preceding systems, to be essentially erroneous. If a work of petralogy were therefore founded upon this theory, it must fall with it: and no writer of judgement or industry would choose to risk his labour upon such an uncertain foundation. Nay, if the theory were invincible, the arrangement would still be improper for a student of petralogy; who must follow the best mineralogical authors, and arrange substances according to their chemical compositions, and other infallible rules arising from the nature and appearance of the substances themselves, whether they exist in nature or in cabinets. A general treatise on rocks therefore cannot be founded on any theory of their formation, however plausible; as the opinions of the author will be biassed by that theory, and he will be inclined, like Buffon, to reject or pass in silence any substance which interferes with his preconceptions. Thus jasper is totally omitted by Werner, though it form a chain of mountains in Siberia, of more than a thousand miles, extending even to the islands between that region and America. A disciple of Werner is therefore embarrassed when he sees specimens of rocks, not disposed in a theoretical sequence; and, in his vindication, boldly asserts that rocks can only be studied in nature, where the formations indicate the series of substances. But as this argument would be ridiculous if applied to lithology, or the knowledge of small or precious stones, so it is equally inapplicable to petralogy; the distinctions between large stones being as certain, and still more useful to society. The knowledge of small and precious stones has been accompanied and greatly assisted by the constant introduction of new denominations, which at present amount to about two hundred; while the rocks of Werner do not exceed sixty, although the distinctions between the rocks be not only more numerous, but more apparent than those between the parasitical stones. If the systems of botany and zoology were founded on progressive formations, it is evident that no two authors could agree upon the links of the chain; and such systems have accordingly been founded upon characteristics derived from their ex[illegible]ior for[illegible] while, in mine[illegible], the forms of the greater [illegible] s l [illegible] c [illegible] and [illegible]er recourse must be had to [illegible], as w[illegible]rior qualities. But, in the former, it [illegible] not [illegible] substances forming the combination, [illegible] the [illegible]ode or m[illegible] of that combination, which constitutes the essential d[illegible]ence among the objects of mineralogical knowledge; for diamond is only a modification of coal, and the sapphire of clay and iron rust. Hence, while the mode of the chemical combination establishes the most essential difference, the structure and the aspect constitute [illegible] minute distinctions. It may also be observed, that Werner's method of distinguishing rocks, by their formations and positions, seems at variance with his treatise on the external characters of minerals, in which the science is rightly founded on its only firm foundations, those depending on the characteristics of the substances, as considered in themselves. This object was perhaps considered by Werner as already accomplished in that treatise, and in his lectures on Oryctognosy, or the general knowledge of minerals: but the rocks form a class so important and distinct, that they deserved a separate consideration, before proceeding to the bold design of general geognosy or geology. Perhaps the experience and observations of two centuries may still be wanted, before such a design can be reasonably attempted; and at present the Huttonian system has as many adherents as the Wernerian, though founded on principles totally opposite: but, in all events, it was necessary to begin with an elementary work, containi[illegible] all the erudition already acquired on the subject, leading to more clear and precise views, or exact distinctions, and a consequent increase of denominations, without which even theory must be embarrassed; for at present it is not even agreed what object precisely constitutes granite, and what object basalt. All theories, however, tend to the advancement of science, by stimulating inquiry and discussion; but it is clear that the theories must be vague, and the contests alike fruitless and endless, till the parties shall have agreed

Necessity of new names and definitions.

upon the denominations and definitions. For what hope of any reconcilement of opinions, or any clear knowledge, when the French persist at this moment in regarding basalt as compact lava; while Dolomieu, the greatest of their mineralogists, and at the same time a practical and sedulous observer of volcanoes, has loudly declared that the basalt of the ancients is never a volcanic product?

Petralogy therefore, or the knowledge of rocks, must, like the other branches of mineralogy, be studied in cabinets as well as in nature; and in the substances themselves, not in supposed theoretical positions: for if the student cannot distinguish a rock without these adventitious aids, which in the great variety of nature will themselves often lead to false conclusions, he may be pronounced as truly ignorant of the subject, as he who cannot distinguish gems without being informed of their countries, sites, and gangarts. And this would be the more absurd as it is self-evident, as already observed, that large substances must present more palpable and more numerous distinguishing characteristics than the minute.

It must also be considered that Werner, by founding the knowledge of rocks on a system of geognosy, has been led by juxta-positions, and other accidental circumstances, observed in the *confined scale of* Saxony, to diminish rather than to enlarge the number of denominations; the result of which practice would evidently be to obstruct the progress of the science; and, as he is not versed in erudition, his own denominations are sometimes unclassical, and so vague, as to give no positive idea; of which examples may be found in his flinty slate, his slate porphyry, and his white-stone. Indeed his new denominations in lithology being often founded on colour, have been sometimes rejected*. To institute new denominations, it is evident that erudition is necessary; and this leads me to observe, that the study of preceding works on the subject is indispensable to a complete treatise on petralogy, which should enable the student not only to know the substance, but the denominations used by former mineralogists and travellers, and by historians, philosophers, and poets, which will not only enlarge his ideas but give him more accurate knowledge. And as few of the sciences can be founded on personal observations, *vita brevis, ars longa,* and the brevity of human life will not permit a petralogist to pass forty years in the Alps with Saussure, thirty in Saxony with Werner, &c. &c. he will of course acquire infinitely more knowledge by the study of their works, than by any personal observations; so that this science, like all others, results from accumulated knowledge.

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* When he classes the gems as siliceous, instead of argillaceous, he confounds them with the false gems (rock crystals, &c.), which are siliceous.

Studies requisite.

These observations shall be concluded with Werner's arrangement of the rocks.

Werner's rocks.

CLASS I. *Primitive Rocks.*

1 Granite.
2 Gneiss.
3 Mica Slate.
4 Clay Slate.
5 Primitive Limestone.
6 Primitive Trap.
7 Serpentine.
8 Porphyry.
9 Sienite.
10 Topaz Rock.
11 Quartz Rock.
12 Primitive Flinty Slate.
13 Primitive Gypsum.
14 White-Stone.

CLASS II. *Transitive Rocks.*

1 Transitive Limestone.
2 Transitive Trap.
3 Grey Wacke.
4 Transitive Flinty Slate.
5 Transitive Gypsum.

CLASS III. *Floetz or Stratiform Rocks.*

1 Old Red Sandstone, or first Sandstone Formation.
2 First, or oldest Floetz Limestone.
3 First, or oldest Floetz Gypsum.
4 Second, or variegated Sandstone Formation.
5 Second Floetz Gypsum.

6 Second Floetz Limestone.
7 Third Floetz Sandstone.
8 Rock Salt Formation.
9 Chalk Formation.
10 Floetz Trap Formation.
11 Independent Coal Formation.
12 Newest Floetz Trap Formation.

CLASS IV. *Alluvial Rocks.*

1 Peat.
2 Sand and Gravel.
3 Loam.
4 Bog Iron Ore.
5 Nagelfluh.
6 Calc-tuff.
7 Calc-sinter.

CLASS V. *Volcanic Rocks.*

Pseudo Volcanic Rocks.

1 Burnt Clay.
2 Porcelain Jasper.
3 Earth-Slag.
4 Columnar Clay Ironstone.
5 Polier, or Polishing Slate.

True Volcanic Rocks.

1 Ejected Stones and Ashes.
2 Different Kinds of Lava.
3 The Matter of muddy Eruptions.

§ 4. *Admission of Iron as an Earth.*

Admitted by former authors.

The admission of iron, not as a metal, but as an earth, may occasion some hesitation; and a few preliminary observations become necessary. Many eminent mineralogists and geologists have led the way to this improvement, though they have not formally introduced it into a system. It may be preferable to adduce their testimonies in chronological order.

Linneus.

Linneus has thus expressed himself, in his brief and emphatic language: " I have sedulously enquired, during my various travels, into the production of stones, and have learned that it is effected by precipitation and crystallisation; and that earths are deposited, while quartz, felspar, and mica rise up. The female earths are impregnated by the male salts, whence a more noble progeny; but many of the latter are derived from Iron, a Proteus who changes according to the disposition of each wife."* He thus insinuates his opinion of the wide influence of iron, a metal which belongs to all ages and formations; and whose power is prodigious and perpetual, even in animal and vegetable life. Bergman has indeed asserted a similar wide diffusion of gold, which has escaped the more recent and precise tests of chemistry, and is now rather regarded as imaginary; while the most numerous and exact experiments more and more evince the universality of iron, which drops even from the atmosphere as the chief ingredient of what are called meteoric stones, and supplies volcanoes from the lowest abysses of the earth. Iron, the grandest of the metals, is not only the most widely diffused, but the most useful to mankind in all the stages of society, and without it civilisation would be unknown; as it furnishes the spade and the plough to the agricultor, tools to the artisan, the compass to the mariner, armour and weapons to the hero, and ink to the eternal theme of the author. But waving these considerations, Linneus has thus sufficiently expressed his opinion of its influence in the constitution of rocks and stones.

Influence of iron.

Cronstedt.

Cronstedt, who may be called the grandfather of modern mineralogy, as Bergman is the father, had long ago a faint discovery of this truth; for among his nine earths, several of which have since been discarded, he reckons Garnet Earth, which, as that substance is strongly impregnated with iron, can only be the siderous earth here mentioned. Bergman also, in his Sciagraphia, which laid the foundations of modern mineralogy, especially reckons the ferruginous among the six principal earths, as he includes the barytic. In his account of carbonate of lime, he mentions that it is seldom free from

Bergman.

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* Lithogenesiam studiose in itineribus quæsivi, dedicique eam absolvi Præcipitatione et Crystallisatione; atque Terras prosterni, sed Quartzum, Spatum, Micamque, exsurgere. Terras femineas dein impregnari a Salibus masculis, indeque prognasci Nobiliores; horum vero plurimos a Marte, Proteo magis mutabili, pro indole cujuscunque conjugis. *Linn. a Gmelin*, p. 4.

iron, which is found even in the most transparent, the calcareous spar of Iceland; "and it may be said in general that all minerals contain that metal."*

Kirwan.

To these eminent testimonies may be added Kirwan, who has nearly approached to this division; for, after describing the simple earths, he proceeds as follows:

"*Calces of Iron.* To these simple earths we must also annex the consideration of calces of iron, as they almost always accompany earthy or stony substances, are mixed or combined with them, and are the source of many both of their external appearances and internal properties.

"Calces of iron are formed of iron, combined with different proportions of pure air, and frequently of water also, and fixed air.

"One hundred parts metallic iron are capable of taking up 66 or 70 of pure air. When 100 parts iron contain but 40 of this air, the compound is still magnetic."†

In another place, after observing that any earth which forms less than one twentieth of a compound, is seldom of any importance, he proceeds to state that calces of iron influence in some measure the properties of a compound, even when they do not exceed one thirty-third part of the whole, that is, three in the hundred; and if they be themselves magnetic, they communicate that property to compounds of which they form above one tenth‡.

In a later production, and with more ample information, he presents the following remarks. "The proportion of the different materials contained in the chaotic fluid to each other, may be supposed upon the whole nearly the same as that which they at present bear to each other; the siliceous earth being by far the most copious; next to that, the ferruginous; then the argillaceous and calcareous; lastly, the magnesian, barytic, Scottish, and Jargonic, in the order in which they are named; the metallic substances (except iron) most sparingly." After such illustrious authors, it is scarcely necessary to mention the similar ideas of Lametherie*.

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* Fr. tr. 1792, i. 170. ii. 378.

† Min. i. 17. Calces were powders, now called oxyds. Thomson, i. 132.

‡ Ib. p. 48. In his treatise on the Magnet (Mem. R. I. A. vi.), Mr. Kirwan says that iron abounds in all minerals, from 2 to 25, but at a medium 6. This globe, he adds, is 4.5 heavier than water; and, p. 182, thinks the centre iron; and afterwards calls it a great magnet, in which Haüy coincides.

Dolomieu. In his celebrated memoir on rocks, Dolomieu observes that they are chiefly composed of four principal earths, to which may be joined iron, or the earth which produces it: and he adds that, in this memoir, "he never considers iron under the relation of its metallic properties, but as a simple earth, susceptible of the same kinds of combination as the other elementary earths."† In his theory, Dolomieu supposes that the precipitation of the principal earths took place in the following order: the siliceous, the argillaceous, the magnesian; contemporary with which two last, was that of the ferruginous, or, as it is here denominated from the Greek, siderous; and last of all the calcareous‡.

In the continuation of this memoir he considers the aggregation of the five principal earths, estimated according to its comparative force, to be in the following arrangement: siliceous, argillaceous, ferruginous, calcareous, and magnesian. He remarks, as a singularity in the ferruginous earth, that it often lends more hardness and solidity to masses where it is simply mingled, than it can acquire when it is in a state of purity. He afterwards proceeds to various observations on the force of adhesion of these five principal earths, and gives a table to illustrate this quality.

Patrin. Patrin, who often looks upon nature with an original and inquisitive eye, has introduced many illustrations of the necessity of the siderous division. Among the primitive schisti he enumerates "Ferruginous Slate. This slate is chiefly composed of indurated clay, abundantly mixed with Oxyd of Iron, either black or brown, but sometimes yellow or red, with a little quartz, and a considerable portion of mica. This rock is one of the most common in the northern countries, where iron is singularly abundant. The eastern side of the Ural mountains, for an extent of about five hundred leagues, from north to south, is almost entirely composed of it." He afterwards observes, that in Siberia many mountains are composed of trap or basalt, "containing masses or veins of granite; while the granitic mountains often contain veins and masses of trap or hornblende."* This last observation may be universally extended; and evinces that siderite, and even trap or basaltin, is at least as ancient as granite, which has hitherto been gratuitously admitted as the most ancient of all the rocks. He also adds, that he has seen large mountains of hornblende, or siderite, in the Altaian chain†.

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* Theorie de la Terre, Tome i. p. 435. Tome iv. p. 45, &c.

† Journ. de Physique, Tome 39, for 1791, p. 374.

‡ Ib. 382.

In treating of iron, Patrin observes that the veins or beds of iron ore, are constantly parallel to the beds of the rock, which in the primitive mountains are often vertical, and seem from the first to have formed an integral part of the mountain which contains them; whence Buffon has called them primordial mines; whilst the veins of other metals almost always intersect these beds under different angles, sometimes even at right angles, and evidently appear to have been *of a formation* posterior to that of the rock. He proceeds to observe that the mountain of Blagodat, on the eastern side of the chain of Ural, consists of thick beds of iron, separated by others of slate and a kind of trap. In that of Keskanar, in the same quarter, the celebrated magnets are mixed with a quantity of greenish siderite in small spots, and extremely resplendent when the stone is polished. In the Altaian chain, vertical beds of an ochry slate alternate with compact beds of black iron ore. The primordial beds are chiefly composed of black iron ore, often magnetic; the strongest magnets of Siberia being those which present laminar parts, sometimes of iron, sometimes of hornblende or serpentine. The nucleus of the earth, as he observes, must be chiefly ferruginous, as is not only announced by the general phenomena of magnetism, but by the observations and experiments of Maskelyne and Cavendish, which show that the specific weight doubles that of rock crystal*.

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* Min. i. 120, 127. † Ib. 132.

In his mineralogy, Patrin begins with a description of the primitive rocks, which he introduces by that of the chief substances of which they are composed, namely, quartz, felspar, mica, and schorl. This last term is generally used by the French geologists for siderite or hornblende. "Often," says Patrin, "it forms considerable masses of rock, and even entire mountains. When the schorl-rock presents a distinct laminar texture, it is called hornblende; when the texture is of an earthy appearance, it is named *Cornéene*." This last word is often used by the French for basaltin. Thus, in the opinion of this great observer, who has passed many years in the mountains of Siberia, schorl or hornblende, composed of siderous earth, is as primitive as any of the rocks†.

Magnetism.

But while these great geologists admit the ferruginous or siderous among the principal earths, they seem never to have connected this idea with that of most writers on magnetism; who, in order to explain that phenomenon, are forced to admit that the nucleus of this our planet is a mass of iron: and as, according to all theories, the substance which is nearest the centre must be the most ancient, of course the siderous earth must often partake of this antiquity; and instead of ranking it, with Dolomieu, in the third or fourth succession, it may be more properly classed in the first. In the mica of granite, and often in the felspar, and even in the quartz, a portion of iron is discoverable: and basalt, which contains a large portion of iron, is sometimes intermixed with primeval granite*. In the other most ancient rocks, particularly those of hornblende or siderite, iron also abounds; as it does in jasper, common slate, trap, serpentine, and the oldest sandstone.

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* Min. v. 11, 48, 241. The mountains of Selinga, he says, are chiefly of hornschieffer and hornblende.

† Siderite and schorl shoot across quartz and felspar, so are more ancient: so siderite and basalt intersect granite.

It may be necessary, however, to introduce a distinction between the Siderous Earth and metallic iron, which must depend upon the proportion to be found in various substances. As the alkaline earths, though they yield metals, will scarcely by any mineralogist be classed among metallic substances; so Siderous Earth, though it yield iron, may be admitted among the other principal substances of that class. In fact, as the recent discoveries of Dr. Davy evince that the alkaline earths, that is the calcareous, magnesian, barytic, strontianic, are of a metallic nature or yield peculiar metals, while he suspects the other earths to be in the like predicament (as the siliceous has since proved), it would be absurd to reject iron as an earth, merely because it yields a metal.

Dr. Davy's discoveries.

It has already been seen that the presence of this earth, even in a small quantity, is so powerful as greatly to affect the compound; and, by altering the quality of its mode, even to change its substance and denomination. Among many examples may be mentioned the hyalite of Dauphiny, which only contains 10 of iron in 100, yet the form of the crystals is that of the iron ore of Elba. Many mineral substances receive their denominations, not from the abundance, but from the influence of particular earths; for the greater part of the argillaceous and talcous rocks contain two thirds or three quarters of silex; so that if the abundance alone were regarded, two of the chief denominations of the mineral kingdom would be rejected. In many instances, the energy of one ingredient has far more force than the abundance of another. An able chemist, after discussing some difficulties of this kind, thus proceeds: "These circumstances no doubt arise from the modes of chemical analysis

Power of iron.

Energy of ingredients.

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* The granite of the Hartz even affects the Magnet. Jam. Min. Sc. Isles, p. 65.

being yet imperfect; and particularly from our being still almost wholly ignorant of what determines the properties of compounds so complicated as minerals generally are. All the ingredients are not to be regarded as equally energetic, or as in the same proportion contributing to the peculiar constitution of a compound; and if one, which in its relation to others is comparatively feeble in its action, be present in large proportion, it leads to erroneous conclusions, when, in determining composition, we attend merely to the relative quantities of the principles, without attending to their relative energies. This has been generally hitherto done; and among the earthy fossils, the predominating principle has always been regarded as that which is present in largest proportion, though the reverse is probably frequently just."*

§ 5. *Miscellaneous Observations.*

This introduction shall be closed with some miscellaneous remarks, which may not be found unuseful for the previous consideration of the reader.

The science too extensive.

A grand cause, as elsewhere observed, of the slow progress of mineralogy, when compared with other parts of natural history, is that it is too wide for the labours of one man; whence some important parts have remained uncultivated, while others, often comparatively minute, have been discussed with great care and anxiety, according to the peculiar studies and inclinations of the several authors. The progress of zoology and botany has been greatly assisted by the publication of detached works upon several divisions; and even the mosses and lichens have been found sufficient for one man's attention, in the brevity of human existence. Recent authors upon these two kingdoms have hence been enabled to glean the most interesting topics, and to form general compilations of great merit and accuracy. For as *vita brevis, ars longa,* was the axiom of Hippocrates, who compiled his classical productions on medicine from cases preserved in the temples, so in all the other sciences, the mere observations of one man will not constitute a science or a system. Saussure passed forty years amongst the Alps; and if the years consumed by other travellers and authors, whose works have been used in the present compilation, were computed, they might amount to a thousand; a period belonging to nature and science, but not to man. Hence the utility of general systems or compilations, which, by combining in one view the observations of practical or scientific predecessors, not only by collation and elision render them more intelligible, but ascertain the progress attained by any science; so that future diligence may not be wasted in the investigation of subjects already illustrated, but be directed to such parts as remain uncultivated and obscure. In this also, as in the other sciences, more genius is required to build a system, than to make observations. In the latter, Newton must yield to Herschel.

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* Murray's Chemistry, iii. 7. He had already said, p. 5, "each simple earth giving its name to an Order, under which are arranged the fossils in which it is *predominant*, or to which it gives a *predominating character*." And so Bergman, the father of modern mineralogy, in the preface to his *Sciagraphia*, 1782: "I have derived the *genera* from the *dominant* principle; and the *species* from the diverse mixtures."

Utility of compilations.

Petralogy differs from geology.

As the study of mineralogy commenced upon principles afterwards found to be inadequate and erroneous; so, by a similar fatality, the study of rocks has been confounded with what is called geology, or the doctrine of the constitution of this globe, which rather belongs to natural philosophy. Petralogy, like lithology, or metallogy, is a science which must be studied by the geologist; but a theory of the earth may as well be studied in a pebble, as in a rock; and the neglected plains, as being nearer the centre of the earth, must afford more topics than the lofty rocks and the mountains. There is no reason, therefore, particularly to connect petralogy with geology, or what some call geognosy: and it would be alike absurd and useless if a rock could not be classed, without a dissertation to determine its antiquity. Nor can any reason be perceived why Werner should regard empirical characters as the chief in regard to the rocks, while he justly considers them as the last and meanest in the consideration of other mineral substances. Here, as in other provinces of the mineral kingdom, there is no infallible guide but Chemistry; upon which alone a rational and durable system can be founded. And if, as some few suppose, chemical operations lead us to educts instead of products, the difference remains the same, and the distinctions equally clear.

Futility of little tours.

Yet some ingenious men, who have made a tour of a few hundred miles, aspire to the study of geology, and speak of their observations with all the pride of ignorance, and all the vaunts of enterprise; while one simple perusal of Saussure's work would teach them that they knew nothing. In the momentary duration of human life, as man writes with his hand on the table and his foot in the grave, infinitely more knowledge must be acquired by the study of former authors, than by trifling observations, which would probably not even have been made if the fugitive traveller had previously studied the subject, or had even once revisited the spot, as Ferrara has observed of Dolomieu. While an author in his cabinet studies the whole globe, and the collective labours of two thousand years, these little journeys only impress him as puerile excursions; and, in conversation, he regrets to find the smallest tourists the greatest boasters. Da Costa has illustrated this truth by a ludicrous story: Dr. Meara, having the greatest respect for his own abilities, and regarding his own discoveries with much admiration, was travelling on Landsdown near Bath, when he observed a kind of chalk, of quite a new species if not genus, being of a white colour, remarkably pure, but above all very hot in the mouth; and in consequence he wrote a dissertation to prove that this chalk alone was the long investigated cause of the heat of the Bath waters. This celebrated discovery has passed into the last edition of the valuable mineralogy of Wallerius, who even quotes Da Costa as his authority for this new chalk, though that patient writer had only mentioned it, to inform his readers that it was unslacked lime, which had fallen from a broken cart.

Study of rocks.

Such tourists, while they have themselves seen as little as they have read, are as loud as Dr. Meara in their assertions that rocks can only be studied in nature; while, in fact, it is as impossible to discern rocks from nature alone, as from books alone. The one must assist the other. The vagueness of ideas in the works of Dolomieu and Faujas, and many other observers, is such that nothing can be learned. But how distinguish rocks, or acquire accurate knowledge, from works of which the authors cannot distinguish a granite from a porphyry, &c.? If, in zoology, a horse was called a lion by one writer, a tiger by another, a leopard by a third, and a panther by a fourth, what knowledge could be acquired? or if, in botany, the rose of one author was the lily of another, while others styled it by a hundred different names? While Buffon and his disciples speak with contempt of nomenclature, they might as well tell us that in civil history the actions of Pompey might be ascribed to Cæsar, and those of Anthony to Cleopatra, for of what consequence are names? Saussure, with his usual judgement, pursued a very different course; and the most laborious parts of his work are evidently those in which he attempts to establish a precise nomenclature. It may safely be asserted that the science can have no foundation till a precise and rich nomenclature be established; and that till then it will remain a chaos, and not a world.

Necessity of exact nomenclature.

The student of rocks must therefore begin with a precise nomenclature, as otherwise his observations cannot be of the smallest utility. If he mean to pursue this study, he may also find it more interesting to pass from this arid subject to the beauties of crystallisation and the metals; and thus from great and general ideas descend to minute. The student of zoology would scarcely begin with entomology. But even among the authors of mineralogy there are ore and dross: and who would believe that an hundred authors have fallen into the grossest errors concerning ophite, &c. because they neglected to consult the original passages?

Apology for this work.

In the present work, it is hoped that the want of attention, care, or labour, will not be accused. The author has sedulously employed the intervals of ten years in this production, particularly three which he passed at Paris, where he had constant opportunities of seeing the most opulent cabinets, and of conversing with men eminent in the science, as Patrin, Gillet Laumont, Daubuisson, and others; not to mention interviews with Haüy, and with Werner during his short stay in that capital. It was resumed at intervals of other studies, the change of labour being itself an amusement. He hopes the work may at least aspire to the humble praise of utility, the chief aim of his labours: *terar dum prosim.* In the preface to his grand treasure of ancient knowledge, Pliny has observed that it is laudable to mention the authors by whose works you profit. Not contented with exact references, the author has often adduced the original passages, not only for the sake of greater accuracy, but to save the reader the trouble and expense of consulting many works, which perhaps contain only a few pages on this particular subject, which has hitherto been treated as a mere appendage to mineralogy. There are also numerous extracts of great value, from works in foreign languages, of which, from their nature, the English reader can scarcely ever expect to see complete translations. These extracts will, it is hoped, from the variety of the style, throw some flowers over a subject proverbially barren; while [illegible] expressions of the observers themselves, in the [illegible] arising from grand phenomena, sometimes enliven the subject with somewhat of a dramatic interest. It must also be remembered, that mosaic is even more difficult than painting, and of incomparably longer duration. Some regard, as [illegible] in literature, that a book should be as comp[illegible]ible; and a reference to a work, which he can neither procure nor read, would contribute little to the instruction of the learner. The candid will likewise consider the entire novelty of the plan;

which, while it required a minute attention to the congruity of the parts, must also, like a new road, lead to mistakes and deviations, perhaps more numerous than the author can conceive; and which, if pointed out with benevolence, he will be ever ready to correct with gratitude. "Those who have gone before us," says an ancient classic, "have done much, but they have not finished; much labour still remains, and much will remain; nor will an occasion be wanting of adding somewhat even to authors who shall be born after a thousand ages."*

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* Sane multum illi egerunt, qui ante nos fuerunt, sed non peregerunt; multum adhuc restat operis, multumque restabit, nec ulli nato post mille secula præcludetur occasio aliquid adjiciendi. SENECA.

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CORRECTIONS AND ADDITIONS.

VOL. I.

P. 21, Note. Compare Ferrara's accounts in Dom. XII.

85, Note. Verd d'oeillet may be the peculiar light sea green of the *grass*, or leaves, of some pinks or carnations.

98, l. 13. *For* Eisenthorn, *read* Eisenthon.

106, l. 21. The analysis of Slate and Mica Slate, by Daubuisson, is in the Journ. de Ph. Juin 1809.

Silex	48, 6
Argil	23, 5
Magnesia	1, 6
Peroxyd of Iron	11, 3
Oxydated Manganese	5
Potash	4, 7
Carbon	0, 3
Sulphur	0, 1
Water and Volatiles	7, 6
	98, 2
Loss	1, 8
	100.

This he compares with Klaproth's analysis of Mica, which yielded, Silex 47, Argil 20, Oxyd of Iron 15, of Manganese 2, Potash 15.

137. Col. Imrie (Tr. Wern. Soc. i. 454), says, the glutenite near Stonehaven consists of pebbles of quartz and porphyry, with some of jasper, hornblende, hornstone, cemented by a reddish brown ferruginous clay, mixed with minute particles of quartz and mica, but which only fills the intervals. At Oban

the cement appears a blackish grey indurated sand, composed of argil, fine sand, black oxyd of iron, and is slightly coherent. It is singular that this glutenite is vertical on the E. and horizontal on the W.

P. 155, Note. The *Black Forest* Mountains form another example.

167, Note. *For* ava, *read* lava.

374, Note. *For* Voyage, *read* Journey.

345, l. 8. *For* Marbois, *read* Marboré.

VOL. II.

64. Compare the sites of Miagite in the Appendix.

100, l. 2. *For* resemble to, *read* resemble.

221, l. 2. *For* Roy. *read* Roz. that is, the Journ. de Ph. by Roziere.

267. The following account of the fall of Rosenberg may not be unacceptable.

" On the 2d September, 1806, at five in the evening, the Knippenouhl Rock, which formed the summit of Mount Rosenberg, was on a sudden detached from its situation; and at the same time part of the mountain, of several feet thick, on the western side, and about 280 feet thick on the east side, gave way, and fell into the valley which separates the lake of Zug from that of Lauwertz. One part of the mountain fell into the lake of Lauwertz, which caused such an agitation in the waters of the lake, that they overthrew a number of houses, chapels, mills, &c. along the southern shore. Upwards of one thousand persons were the victims of this calamity. A society of thirteen travellers were on the road from Arth to Schwitz: nine, who walked first, perished; the other four escaped. In this convulsion enormous pieces of rock were carried through the air to prodigious distances. The lake of Lauwertz has lost above a quarter of its extent. That rich plain which was so beautiful, now presents a mountain of near one hundred feet in height, a league and a half in length, and as much in breadth. The villages of Goldau and Rothen, consisting of one hundred and fifteen houses; that of Busingen, of one hundred and twenty-six; and that of Kuslock, have totally disappeared. Of Lauwertz, which lost twenty-five houses, there remain ten buildings, all much damaged. Twenty years since general Pfyffer predicted this catastrophe, from the knowledge that he had of the nature of the mountain. A professor of Schwitz said, that above Spietsfleu was a sea of water, which had undermined the rock for several years, and that below there was a cavern of great depth, where the waters were engulphed. The quantity of water which has fallen during the preceding years has hastened this catastrophe, and the rains of some weeks past have decided it. On the 10th eight hundred persons were employed in digging for the bodies of those who were destroyed by the falling of the mountain at Schwitz. In forming a channel to draw off the waters, between thirty and forty labourers were swallowed up by a torrent of muddy water, which broke in upon them suddenly."*

Besides the plates and description published at Paris, there are three large views drawn and engraved by Wiebel, a Swiss artist, which the author has seen. The effect is not that of a fallen cliff, as in granitic mountains, but that of masses of rock, detached and thrown down a gentle declivity, with such impetus as to overwhelm every obstacle, and spread to an amazing distance.

P. 306, l. 5. *For* tufa, *read* tufo.

401, l. 16. *For* PRODUCTION, *read* PRODUCTIONS.

428, *Marginal indication. For* Former rocks, *read* Forms rocks.

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* Annual Reg. 1806, p. 448.

[illegible]

Grand Cavern, Staffa

DOMAIN I.

SIDEROUS.

◆

SIDEGEA, SIDEROUS EARTH.

THE name *sidegea*, as not unusual in compounded words, is abbreviated from two Greek terms, signifying iron and earth. The reasons for the introduction of this grand division, adopted in substance by the most eminent geologists, have already been given. Iron acts so important and radical a part in the constitution of our planet, that it deserves to be viewed under various aspects, not only as a metal, but as an earth, strongly impregnating most of the others, and often exerting a predominating influence. For as, since the recent discoveries, many earths have been known to assume the form of metals, so there can be no impropriety in considering this [illegible] metal under the form of an earth.

When a substance contains more than twenty-five parts in the hundred, or, in other words, one quarter, of iron, it may be worked as a metallic ore, and arranged under that denomination. But in a smaller quantity it will fall under the present division, especially when intimately combined with the other earths. It was by metallogists considered as a calx, or latterly called an oxyd. Mr. Kirwan*, who has rightly added calces of iron to his description of the earths, says, that they are formed of that metal, combined with different proportions of pure air, and frequently of water also and fixed air.

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* Min. i. 17.

"One hundred parts metallic iron are capable of taking up 66 or 70 of pure air. When 100 parts iron contain but 40 of this air, the compound is still magnetic." His table of the fusibility of the simple earths presents some curious experiments on the mixture of calcined iron and rust of iron, with other substances, which show the power of this metal. Even when it only amounts to four parts in the hundred, it sensibly influences the compound.

Sidegea, or siderous earth, is so generally diffused, that almost every mineral substance derives its colour from it, from a pale blue to the deepest red. Animal substances contain it; and it exists in the vegetable kingdom, even in plants apparently supported merely by air and water. It would appear that even the atmosphere abounds with atoms of iron, whence perhaps the meteoric stones.

MODE I. SIDERITE.

Distinctive characters.

Texture, generally crystalline, as in the saline or primitive marbles; the prisms sometimes intersecting each other, so that it becomes difficult to determine their figure*. The grains are sometimes so small that it assumes a compact appearance, in which case it passes into basalt.

Hardness, basaltic, sometimes only marmoric. Fracture commonly foliated, sometimes radiated, tough. Fragments rather sharp.

Weight, siderose: sometimes approaching the barytose.

Lustre, splendent, shining, between vitreous and pearly. Opake; the green sometimes translucent on the edges.

Colour generally black, sometimes of a greenish grey.

Siderite sometimes composes entire mountains, but more commonly occurs disseminated, or forming veins or nodules, in granite; or beds in gneiss.

Hornblende.

This important substance, which is y
disseminated, is the *hornblende* of the
miners; a barbarous term, which, like

---

* The crystals of siderite are of an oblong quadrilateral form, while those of mica are hexagonal.

others, had passed into the science before it became classical*.

Sites.

"Mountains of black hornblende exist in Siberia, Renovantz, 32: as the Tigereck, 4 Nev. Nord. Beytr. 192; and others mentioned by 2 Herm. 271. Frequently mixed with quartz, mica, or felspar, or shorl, and either greenish or black. Ibid. But it is more commonly found in mighty strata, as in Saxony; or still oftener as a constituent part of other primeval rocks, as in syenite and grunstein; sometimes in layers in gneiss, or granular limestone, or argillite; and sometimes in horn porphyry. 2 Berg. Jour. 1788. 508. 1 Lenz. 325. 1 Emmerling, 325; or in the gullies of granite. Herm. Ibid. Hornblende slate was observed among the primeval rocks on the ascent of Mont Blanc, 7 Sauss. 241, 253, mixed with plumbago; Ibid. and on its summit, Ibid. 289."

"Strata of schistose hornblende occur sometimes in gneiss, as already mentioned. At Mil-

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[*] *Blend*, in German, sometimes implies *blind*, sometimes *false* or *deceitful*; but the name seems rather to have arisen from its having the appearance of *blende*, an ore of zinc, which was also called *pseudo galena*. *Blend*, or in modern German *blind*, never has the final *e*: and there would be no sense in *blind horn*. But as the substance much resembles black *blende*, and, when struck, often *crumples like horn*, the etymology is very clear. A French writer rightly translates it *Blende de corne*. Hornstein and Hornsilver are *translucent as horn*.

tiz a stratum of it has been found over granular limestone. Voigt Prack. 33. In Lower Silesia it has been found on syenite. 4 Berl. Beob. 349. Granite sometimes rests on it. 2 Berg. Jour. 1790, 300. Voigt Mineral. Abhandl. 25. Hence there can be no doubt of its being a primitive stone. A mountain of it exists in Transylvania; 1 Bergb. 40. Nay, granite has been found in it. 1 Berg. Jour. 1789, 171. It is frequently mixed with mica, more rarely with visible quartz: Emmerling*."

Patrin observed in Siberia many mountains entirely composed of siderite, and containing masses or veins of granite; while reciprocally the mountains of granite often present veins and masses of siderite†. These accidents are particularly frequent in that part of the Altaian mountains which approaches the river Irtish.

It also abounds in Bohemia, Saxony, Tyrol, and many other countries, not to mention the isles of Arran, Col, and Tirey; the district between Lochlomond and Dunkeld, and other parts of the Highlands of Scotland; and also near Holyhead in Wales.

Saussure describes, § 674, a strange mixture of massive granite with a grey heavy rock, which on the outside appeared of a rust-colour. This is evidently a siderite, of which the iron is decomposed. He justly observes, that both must have crystallised together, and of course siderite must be as ancient as granite*.

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* Kirwan Geol. Ess. p. 181.

† Min. i. 127.

The rocks of siderite are by Werner classed among the Primitive Traps, which he divides into the common, the granular, and the schistose; with two mixtures, siderite with felspar and with mica. The admixtion of mica and pyrites is by Daubuisson regarded as characteristic of the primary traps. That of siderite and felspar constitutes the primitive *grunstein* of Werner, including the common, the porphyritic, the grunstein porphyry, the green porphyry of the ancients, and grunstein slate; which latter has, according to Daubuisson, been called *hornschiefer*. Some of these primitive traps have been arranged under the large and vague denomination of *cornéenne*, *roche de corne*, *pierre de corne*†, by the French mineralogists; and even by Saussure, who tells us, § 1225, that when the *cornéenne*, or *pierre de corne*, has marks of crystallisation, it assumes the name of *hornblende*. But as the stones, confessedly called basalts by

Primitive trap.

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* The summit of the Dome du Gouté consists of siderite in a state of decomposition. Id. § 1980.

† *La pierre cornée* is petrosilex.

the ancients, often present marks of crystallisation, being sideritic rocks or primitive traps, they shall be considered under that division. Wad, in his account of the Egyptian minerals in the Borgian Museum*, observes, that the basaltic monuments of the ancients are referable to two classes; 1. The primitive, consisting of black hornblende, or siderite, which is sometimes so mingled with veins of felspar, and often with quartz and felspar, partly rude partly crystallised, that it is in some examples difficult to determine whether they should be placed among the basalts, or syenites, of Werner. 2. This class appears of more recent formation, and in all respects agrees with the basalt of Werner, except that it be more hard, owing to the interspersion of minute particles of quartz, being very similar to the stone with which the ancient Roman ways were paved, and which is by some called lava. Some of the ancient *basalts* therefore cannot be distinguished from *siderites*, as the ancients were not conversant in the minute discriminations of modern science: and some monuments which they would have called basalts, a modern mineralogist would rank among the black granites. But as the ancients cannot be our guides in mineralogy, a science to them

Ancient basalt.

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* Fossilia Ægyptiaca Musei Borgiani. *Velitris*, 1794, 4to. p. 7.

utterly unknown, it is sufficient to say, that the rocks which the acute Werner, and his disciples, have classed under HORNBLENDE, here appear under SIDERITE, and some of their TRAPS under BASALT; while the trap of the Swedes, with a fine grain, is here called BASALTIN. The difference indeed is rather in the transition; the chemical analysis of siderite and basalt being nearly the same.

SIDERITE.		BASALT.	
Silex	37	Silex	50
Argil	22	Argil	15
Magnesia	16	Magnesia	2
Lime	2	Lime	8
Oxyd of iron	23	Iron	25
	100		100

It scarcely needs to be observed, that in all substances the proportion of ingredients varies according to circumstances.

In general therefore where the substance has a crystallised and silky appearance, it must be classed among the siderites; but when it wears a dull or earthy aspect, it belongs to the basalts, though in the latter shining crystals of siderite may be interspersed.

When mica alone is found in a substance, it cannot alter the denomination, for, as Mr. Kirwan has observed, there is scarcely a mineral in which it may not be found. But the mixture of siderite with felspar deserves a distinct appellation. The term *grunstein* or *green stone*, used by Werner, has been deservedly ridiculed, as alike vague and barbarous. He borrowed it from the Swedes, whose grunstein was really green. It is further objectionable, as he extends it to green porphyry, and other mixtures of earthy trap or basaltin. As many new appellations are wanted, to distinguish with brevity and precision the different kinds of rocks, it is proposed to call this mixture WALLERITE, in honour of Wallerius, the great Swedish father of mineralogy. The other kinds of grunstein are arranged after basalt; as by their earthy texture they differ greatly from the former: nor can the black and green porphyry of the ancients, classed by Werner under this head, be considered as having any other basis than common trap.

Grunstein.

Wallerite.

STRUCTURE I. COMMON SIDERITE.

Aspect 1. Uniform. Black siderite of Egypt. This substance is more generally found mingled with granite; but *scarabæi* and other small sculptures sometimes occur in it, and sometimes in that ore of iron called hematites*.

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* See Wad, p. 8 and 32.

Black siderite from Mount Sinai. Given to the author by Roziere, a skilful mineralogist, who accompanied the French expedition.

Compact siderite, from the isle of Col, Scotland.

The same, from the iron-mines of Sweden.

The same, of a brownish and grey colour, from Finland.

Green siderite, from Sweden.

Saussure mentions, § 1824, beautiful beds of black siderite, in one of which an excavation had been made to extract crystal.

Aspect 2. Mingled. Black siderite, with mica, from Egypt.

The same, with olivine, from Egypt.

The same, with gold and silver, or with *electrum,* a natural mixture of these two metals, from Kongsberg in Norway.

Green siderite, with garnets, from Sweden.

The same, intermixed with iron ore, from Salzburg.

The same, with hard clay, from Vesuvius.

The same, with pyrites, from Arindal in Norway.

The same, from Salberg in Sweden.

The same, from the iron-mines of Dognaska, in the Bannat of Hungary.

The detached crystals of siderite, and what is called Labradore hornblende, or schillerspar, if it be not another substance, are properly topics of gemmology, or lithology, and not of petralogy, as they never occur in the form of rocks. It may be proper to observe, that siderite is called by many French writers *schorl en masse*, and sometimes *schorl spathique*.

The real grunstein of the Swedes is a mixture of siderite and mica, sometimes with particles of quartz*.

Fine grained siderite, with mica, from Upland.

The same, large grained, with quartz, from Smoland.

The same, with spots of steatite, from Taxas in Smoland.

STRUCTURE II. SCHISTOSE SIDERITE.

This substance, the *hornblende slate* of the Germans, is often found in gneiss, as already mentioned; but it is often joined with compact siderite; and, with a greater mixture of magnesia, passes into chlorite slate: for between siderite, chlorite, and actinote, there is a near connexion; whence Saussure argued that chlorite is merely the earth of green hornblende. Compact and slaty siderite also frequently occurs, in large masses, in common slate, a kindred rock.

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* Wall. i. 436. Whence it appears that it was also called *Binda* and *Jernbinda*: the *Saxum ferreum* of our author.

Aspect 1. Uniform. Schistose siderite, of a beautiful silky texture, from Kongsberg in Norway.

Schistose siderite, from Holyhead.

The same, delicately waved, from Norway and the Highlands of Scotland.

Aspect 2. Mingled. Schistose siderite, with garnets, from Kongsberg.

The same, with native gold and silver, from the same.

The same, with particles of quartz, from Saxony.

Schistose siderite in divergent rays, sometimes of a fascicular sometimes of a starry form, from the Alps, where it is often imbedded in granular felspar. This rock will seldom admit of a polish, otherwise it might rival the Miagite, the arborescent granitel found in the ruins of Rome, and other splendid and celebrated mixtures of felspar and siderite, which are here classed amongst the ANOMALOUS ROCKS.

Saussure describes different kinds of schistose siderite in the following terms:

"The schistus composed of hornblende and felspar is very common upon the banks of the Isere, and this is not extraordinary, as there are even entire mountains of it in Dauphiny, which I have myself seen. The famous silver mine of Challenches, into which I descended, is in a mountain of this kind. The varieties of this rock are extremely numerous; we find it with leaves singularly distorted, or bent in zigzag. It sometimes occurs with thick leaves, and at others as thin as paper. In some varieties, the leaves of pure and coloured hornblende, alternate with leaves of white and pure felspar; in others, these two substances are almost confounded; in others, in short, the leaves are interrupted either suddenly or by gradations. There are also frequently found knots or detached pieces of white felspar, confusedly crystallised, and often mixed with quartzose parts. It is curious to observe, when these knots are of irregular shapes, the exactness with which the schistose leaves follow all the convolutions of the knots, and form a kind of fortifications around them.

"The hornblende varies in its colour; sometimes black and brilliant, sometimes inclining to green, at others brown or grey; its form sometimes presents pretty regular crystals, especially in schisti, whose leaves are straight; and at other times thin plates, almost as brilliant as mica, without any appearance of a regular form. It is likewise more or less fusible under the blow-pipe.

"The felspar also varies by its white colour more or less pure, and inclining sometimes to a green or rosy hue; and by its form which, at one time, presents pretty regular rhomboidal laminæ, at others a crystallisation quite confused in small granular masses, like statuary marble. There is sometimes seen in the leaves, as in the knots, a mixture of a little quartz. The felspar which enters into the composition of this schistus is commonly of that kind which I have termed *feldspath sec*, or dry felspar; I have however seen but only one piece, of which the felspar was *gras*, or unctuous." § 1586.

He also mentions—

§ 2227. A green rock, which he would formerly have called *roche de corne*, but must now refer to the hornblende slate of Werner: and,

§ 1971. A gneiss, composed of laminar siderite and felspar, on the ascent of Mont Blanc.

§ 2271. A slate of fine scales of mica and hornblende, sometimes in level plates, sometimes undulated. It is of an olive-green colour, acts faintly upon the magnet, and makes a hasty effervescence with acids; a proof that it contains some calcareous particles.

§ 2131. Near Macugnaga, brilliant hornblende slate, in large redoubled layers, so as to masses three or four inches in thickness, e in dull white quartz.

§ 1822. Beautiful rocks of granular fel with long irregular crystals of siderite, sometimes assume the form of sheaves verging rays. The base of granular felspar been mistaken for a sandstone.

§ 2144. Sheaves of black hornblende, two three inches in diameter, forming a most effect on a white gneiss.

§ 164. Siderite, in the form of a sheaf, or ra fan, on granular quartz, or rather felspar.

§ 1954. Siderite mixed with calcareous par cles, ramifying alternately with quartz.

STRUCTURE III. WALLERITE.

Wallerite.

This rock, as already mentioned, e of primitive grunsteins of Werner, but is r stricted to a mixture of crystalli felspar; the other primitive grunsteins ng c ed after the basalts, to which they more st belong.

Wallerite from Sweden, of black cr siderite mixed with felspar.

The same, greenish black, from Snowdon Wales.

The same, from Mount Sinai.

MODE II. BASALT.

Characters.

Texture coarse, generally mixed with grains of quartz or felspar; it has sometimes a crystalline appearance, but the crystals are minute, so that it appears earthy.

Hardness basaltic. Fracture rather even. Fragments rather sharp.

Weight siderose.

Lustre shining. Opake.

Colour iron grey, sometimes greenish.

Formations.

This celebrated substance is one of the traps, or rather a *grunstein*, of the Swedes and Germans; and is by the Wernerian school considered as of three remote formations, the primitive, transitive; and stratiform, also called *floetz*, or *horizontal*.

Basalt proper.

The basaltic monuments of the ancients are allowed by Dolomieu and Faujas, two chief supporters of the Volcanic system, not to be of a volcanic nature; and of course the restriction of the name to pretended compact lavas is not only objectionable, but highly absurd, as transferring a well-known term to a substance widely different. Compact lava is so uncommon a substance, that there was no specimen of it in the great collection of prince Biscari, at Catania;

while Gioeni and other writers on volcanoes say, that very seldom a piece without pores can be found, even of a few inches in diameter. A specimen of compact lava in the British Museum contains melted garnets; and is of such an appearance that no eye can confound it with basalt, even of the finest texture: yet Faujas, and other late French writers, persist in restricting the term basalt to a supposed lava, while they use the term trap for the real basalt of the ancients; which, even by their own volcanic theory, is of quite a different nature and origin*.

In his description of the Borgian monuments, as already mentioned, Wad found that those of basalt might chiefly be referred to siderite or hornblende: and it is remarkable that the word *basaltes*, according to Pliny, signified *iron* in the Ethiopic language, as *sideros* does in the Greek. The basalts of the ancients are often siderites, sometimes with veins or grains of felspar or quartz; sometimes with olivine: the only antique specimen in which leucite occurs having, as Wad observes, been sculptured at Rome.

Basaltin. Some small Egyptian monuments, however, occur in *fine basalt*, here called *basaltin*: to which last division the basalt or trap of the moderns, and pretended lava of the French mineralogists, properly belongs. For the basalt of Agricola, the trap of Wallerius and Werner, a substance abundant in the Faroe isles*, Sweden, Scotland, Ireland, Saxony, Auvergne, Sicily, &c. may also be traced among the Egyptian and other ancient monuments; and as Pliny informs us that the name of iron-stone was given on account of its colour and hardness, this appellation must have been yet more applicable to fine-grained trap than to siderite, which is of a looser grain and softer cohesion. And while the ancient denominations are so indistinct that they have included green fluor, and the fine green granite of Abyssinia, among the emeralds†, it is easily conceivable that the term basalt was extended to two or three distinct rocks, of a colour and hardness approaching to iron: but even the basaltin, or fine-grained basalt of the ancients, is frequently interspersed with minute grains of quartz or felspar; and monuments of what we would strictly call trap or basalt are comparatively rare. But as it is evident that the basalt of the ancients was more commonly of a coarse grain, and often intermixed with quartz or felspar, it has been thought proper, for the sake of precision, to confine the term to that substance; while the name basaltin is applied to the fine-grained basalt of the moderns, which frequently assumes the columnar form, in which shape also the former sometimes occurs. There is no doubt, for example, that some of the *whins* of the Scottish mineralogists, in which grains of quartz or felspar are mixed with trap, strictly and properly belong to the basalts of the ancients.

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* The name *basalt* seems subject to a singular fatality of abuse, the grave Wallerius having, with equal skill, degraded it to common *schorl*!

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* In the north of Europe. This spelling distinguishes them from Ferro, one of the Canaries.

† There seems little doubt that the pillars said to be of emerald were of this substance.

The dispute therefore concerning the Neptunian or the Volcanic origin of this substance must more aptly be considered as having no concern with the proper BASALT of the ancients, but with the modern basalt, here called *basaltin*. The author of this work is not attached to any theory, nor does he believe that the facts and observations are yet sufficiently numerous to afford even the semblance of a plausible concatenation; but he may be allowed to observe, that though volcanoes are often situated in basaltic countries, as they of course abound with iron, of itself inflammable, and yet more with sulphur, and probably forming the great source of volcanic fires; yet, as there is no proof of any volcano, however vast and powerful, as Etna, or some of those in the Andes, having in any ancient or modern eruption furnished basalt, either in columns or in strata, it would seem an infallible inference that this substance cannot be of volcanic origin*. The wide extent also of this substance, and the common situation of basaltic columns on the summits of hills, strongly militate against this idea. The same formation of basaltic columns resting sometimes on amorphous basalt, sometimes on indurated clay tinged with red ochre† of iron, is found to extend near thirty miles into Ireland from the Giants' Causy, and as far as the northern Faroe isles, a space of more than six degrees, or three hundred and sixty geographical miles; and, it is worth remarking, nearly in the same meridian. In like manner the basalt of Saxony might be said by a theorist to extend through Sweden, even to Spitzbergen; and it is observable that all the northern parts of Europe abound with iron; those of Asia are concealed by perpetual ice, snow, and marshes; while those of America seem chiefly to present copper. T columns of Germany, as is well knc chiefly situated on the tops of hills; and, fi Landt's recent interesting description of the roe isles, it appears that this phenomenor there equally common. A magnificent occurs in the isle of Osteroe.

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* None of the numerous hills around Etna is capped with basalt; nor have the isles ejected by submarine volcanoes presented that substance; so there is no proof of a subaqueous origin. The prisms on the shore around Etna are very rude, and unlike the beauty and exactness of basaltic columns.

† Does the red colour indicate heat, as yellow ochre thus assumes that tinge?

Basalt of Faroe.

" To the north of the village of Ze t is a basaltic hill, which extends more mile northwards: properly speaking, it the bottom of two hills, which lie namely Halgafieldstinden and Rodefielc which are of considerable height, and miles distant from each other. The tic itself is about four hundred and twenty t h and consists of strata of pentagor gonal basaltic columns, placed clc other in a perpendicular direction, ar in a manner that the tops only of the far lumns are seen, while those in front exhit whole form, but appear to be different in l These columns, which rest on a founda trap about three hundred feet in height, largest of the kind in the Faroe islands; fo the rock has been freed from mould, tl lossal pillars may be seen with their lo standing on another species of stone, a to the height of above a hundred feet, in size, being about six feet in diameter. Many of these huge columns, which have fallen down, are now lying at the bottom of the hill; one in particular, sixty feet in length, has been thrown across a deep gulley, with its ends resting on each side, so as to form a bridge over it[*]."

Of dubious origin.

It also appears from Dr. Richardson's recent observations[†], that the basalt in the north of Ireland occurs on the tops of hills, at a great distance, while the intervening space has been, as it were, scooped out by some exterior agency, with which we are at present totally unacquainted. But whether some comet has approached the earth, or some small planet, like one of those recently discovered, has fallen into it, and occasioned appearances altogether inexplicable upon our small scale of observation, most probably may ever remain a matter of theory[‡]: and in natural, as well as in civil history, there are many objects of which the best judges choose to remain in what Mr. Gibbon emphatically calls A LEARNED IGNORANCE. Nor must it be forgotten, that masses of sandstone and limestone are, in like manner, found upon the summits of hills, quite detached from the original beds to which they would seem to belong by the identity of their substance. From these remarks it must appear to every impartial mind, that the phenomena of basalt are on too vast a scale, and of an appearance too uncommon, to be produced even by a chain of volcanoes, of which the Andes present most extensive examples; so that to confine the appellation of basalt, with the French mineralogists, exclusively to a pretended compact lava, would be a mere assumption, alike foreign to ancient erudition, and the precision of modern science.

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[*] Landt, 39.

[†] Ph. Tr. 1808.

[‡] Dolomieu, *J. de Ph.* 1791, p. 385, thinks that an exterior shock has broken the crust of the globe, and raised parts on others. The like ideas may be inferred from the REFOULEMENT of Saussure.

STRUCTURE I. AMORPHOUS BASALT*.

Egyptian. Basalt of a greyish black, with very small grains of white quartz, and spots of iron ochre, from Egypt†.

Basalt of a blueish grey, glimmering lustre, and fasciculated fracture, from the same.

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* It is always of a mingled aspect.

† It is only to be inferred that the Egyptian basalts do not belong to the columnar. Ferber erroneously says, that Strabo mentions the Ethiopic basalt as columnar. That author, lib. 17, describes a pyramid, partly built of basalt, from the extreme mountains of Abyssinia.

h a mixture of amorphous black siderite, inute grains of white quartz, from the same.

same interspersed with transparent felspar, becomes greenish from the mixture, from me.

yish black basalt, interspersed with black , partly amorphous partly crystallised, and reyish white felspar.

same, with black siderite, and small grains owish green olivine.

same, with black siderite, partly amorphous crystallised, olive-green olivine, and scat- particles of black mica.

same, superficially spotted with reddish , probably from the decomposition of the

yish black basalt, interspersed with crystal- siderite, with small crystals of olivine in prisms, of which some being decomposed, rface becomes porous, while the interior is etely dense*.

h is the catalogue of ancient basalts observed ad in the Borgian museum, there not being ne example of basaltin, though it certainly in small Egyptian monuments; and the saw at Paris the statues of a king and

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[*] Such basalts have deceived the volcanists.

queen sitting, in one piece about nine inches in height, the back and sides being covered with hieroglyphics. He also saw in the same collection small fragments of green basaltin, from Egypt.

Patrin gives the following list of ancient basalts*.

Oriental. "Oriental basalt of a blackish grey, of a fine grain, mixed with white scales of felspar, and little veins of quartz. This is the kind most commonly observed in ancient monuments.

"Oriental black basalt. It is mixed with grains of quartz, with small crystals of felspar, and with spangles of mica; these ingredients are not combined as in granite, but interspersed in the black base of trap. The Isis, which is in the court of the Capitol, is of this stone.

"Oriental black basalt, radiated with veins of red granite, in small grains. The two sphinxes, which are at the foot of the great stair-case of the Capitol, are of this basalt.

"Oriental black basalt, with green spots of siderite. It is called at Rome Egyptian stone, or nephritic stone.

"Oriental green basalt. It is of the same base as green porphyry: the only difference is, that the substance of felspar is equally interspersed in it, and is not united in crystals. This base is homogeneous, very compact, and very hard. Fine statues of it are seen in the Capitol, and in the Villa Albani.

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* i. 127. The French authors rarely quote their authorities; but Patrin has borrowed his examples from Ferber's Travels in Italy.

"Oriental green basalt, with white specks. It is the same as the preceding, in which the felspar is united in small crystals: it is named speckled basalt, and is very rare. There are two pillars of it at Rome, in the church of St. Pudentiana.

"Dolomieu says, that there is such a vast number of Egyptian monuments in the Borgian Museum at Veletri, that they are almost sufficient to constitute the whole Egyptian Lithology: many are formed of stones which have qualities attributed to basalts; not one is volcanic."

In passing to the modern basalts, it must be premised that the trap of Wallerius, which he describes as being of an impalpably fine grain, belongs solely to the basalt of the moderns, here called basaltin from that circumstance. But the basaltic granite of this venerable author * certainly includes some of the basalts of the ancients; as that of an iron-colour, mixed with the ore of that metal and quartz, which is found at Norberg, in Westmania. His *saxum ferreum*, composed of various mixtures of siderite, mica, basalt, and quartz, may also sometimes be referred to this Mode*.

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* i. 422.

Basalt, with mica, from Upland in S

Green basalt, with black mica, and
a mixture of quartz, from Westmania.

The basaltin of Kirwan is merely cr
hornblende, or siderite; but the basaltin
de Born is often the real basalt of t
while his basalt is here called
tions that kind, mingled with green
olivine, from Bohemia; and that mi
brown mica, from the same country.
treatise on traps, Faujas confines hin
basaltins, or fine-grained basalts; he
trap, sometimes black sometimes green,
of semitransparent quartz, from Scotla
vence, which may probably be classed
ancient basalts†. The pillars of gru
compose the innermost circle at Sto
also belong to this division‡.

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* i. 437.

† Launay, *Essai sur les Roches*, 64, mentions a mixture of
and felspar, from the isle of Bornholm, Denmark.

‡ Townson's Tracts; whence may also be added the Salisbury Craigs, near Edinburgh, containing siderite and felspar.

following passage of Strabo has been
to imply columnar basalt:
e went to Philoe from Syene in a carriage,
a level plain, the space of a hundred sta-
long almost all the route were to be seen,
sides, in many places, as it were *terms*[*],
d, round, and polished stone, almost spheri-
d of which mortars are commonly made,
upon a larger stone, and surmounted by
. Some even lay apart; the largest being
s than twelve feet in diameter, and the
about half as large[†]."
ral authors have inferred from this passage
trabo means to speak of columnar basalt,
would rather seem to imply a work of art,
nificent avenue from Ethiopia into Egypt.
saltic columns have been observed twelve
diameter; and even if the passage be cor-
and twelve feet in height be intended, or
s two feet in diameter, it would still remain
cure, that it would be adventurous to build
lid argument upon such an uncertain found-

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[*] The little hermetic columns at Athens.

[†] Strabo, lib. 17.

ation. It is singular that Denon, who has given such a minute and interesting account of the isle of Philoe, should have taken no notice of these remarkable monuments. He speaks indeed of large blocks of stone covered with hieroglyphics, but mentions nothing but granite in that quarter; and basalt could scarcely have escaped the attention of a French traveller.

The columnar form is far more c
sumed by the basaltin, than by the re
salt: yet it is found even among other
"Columns of porphyry are not rare;
other places, are found near Dresden,
in length, and not more than two inches in
ter*. Columns of petrosilex compose
portion of a mountain near Conistone lake.
perfect quadrangular prisms of argillaceous
tus are found near Llanurst. Rubble
sumes the columnar form at Bar
limestone near Cyfartha, in Glamor
divided into very regular acute rhomb
even the sandstone of the same district
unfrequently columnar; and one of t
gypsum at Montmartre is distinctly di
pretty regular columns. Sandstone, clay,

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* Strange's *granitic* columns, near Verona, are *porphyritic*, with a paste or basis. Spallanzani.

on ore, and many other substances, be-
matic by torrefaction; and the prisms of
med in drying, have often been consi-
llustrative of basaltic formations*."

the numerous examples of columnar
it is well known that they often oc-
coarser grain, and mixed with felspar
te, thus strictly belonging to the basalt
cients. The columns in the north of
posed to be volcanic, seem chiefly to
this substance. I do not however find
erman mineralogists mention their *grun-*
occurring in a columnar form, though
on has evinced that grunstein and basalt
ame substance. The analysis of Dr.
s as follows:

	BASALT.	GRUNSTEIN.
. . . . . .	46	46
. . . . . .	16	19
. . . . . .	9	8
of iron . . .	16	17
r and volatile matter	5	4
. . . .	4	3½
atic acid . . .	1	1
. . . .	3	1½
	100	100

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[*] Watt, Ph. Tr. 1804.

It would indeed be a singularity , basaltin occurs so often in a colum substance composed of the same ingre never assume that appearance. Yet columnar form of basaltin may it owing to the impalpable fineness of the allowing an exact scission, or crystallisa coarser materials would not admit; are generally composed of finer ingr amorphous substances.

MODE III. BASALTIN.

Characters. Texture finely and almost impalpably granular, sometimes vesicular; on a large scale stratified, rising like successive *steps*, whence the Swedish name *trap*. It sometimes presents distinct concretions, of a finer or of a coarser grain. It seems to split in rhomboids, while the columnar sometimes lapses into globular forms[*].

Hardness basaltic, or between mar spar, about 800 of the scale of Quist. F sometimes even, sometimes conchoidal. ments amorphous; not very sharp.

Weight siderose.

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[*] Mr. Watt, Ph. Tr. 1804, observes, that melted basalt into globules, before it assumes the compact texture.

tre dull, except when mixed with siderite.
e.
our greyish black, greenish, rarely brown
dish.

s is the basalt, or fine-grained trap, of the
ns. Karsten has supposed that even the
basalt is a mixture of impalpable grains of
e and felspar, or quartz; which would in-
ppear to be confirmed by the identity of
hemical constituents. Faujas also argues
our of his volcanic theory of basalt, that
which he allows not to be of a volcanic
e, is merely a granite of a very fine grain.
dea partly rose from the confused and lax
er in which the term granite has been hi-
used; and partly from his theory that
asalt is always a lava. But in this way all
nixed rocks might be classed under granites;
ere is scarcely a mixture which has not
arranged under that head by some mi-
ogist, as the reader may perceive from the
n of Linnæus by Gmelin. It is true that
xture of siderite felspar and quartz would
a genuine granite, and that some of the
ts of the ancients might be classed, as Wad
bserved, among the granitels: but where
iderite so preponderates as to give a great
lence to its colour; and especially where

the particles are earthy instead of being crystallised, as in granite, where the silicious part superabounds; a wide difference has always been allowed. A variation of the same ingredients will indeed ever form one of the chief distinctions in mineralogy; for it must be repeated, that it is not the *ingredients*, but the *mode* of their combination, which forms the chief distinction: diamond being akin to coal; sapphire only consisting of clay and rust; and, among the argillaceous and magnesian rocks, silex is commonly the predominating ingredient, but still the argil and magnesia give the character and name.

But let us listen to the great master of petralogy on this interesting topic.

Saussure's opinion.

"I call *trap*, a rock composed of small grains of different qualities, confusedly crystallised, inclosed in a cement, and sometimes also united together without any distinct cement; and with no perceptible regular crystals, except rarely and accidentally.

"This definition connects traps with
and porphyries; but M. Dolomieu h
very evident that this approximati
exists in nature. He observed at R
masses of granite and porphyry selec
worked by the ancients, as we observe
Alps, and in the blocks that are de

ied transitions between these different [illegible]

nk besides that, in the nomenclature of y, it must be regarded as a principle, to the kinds and species, from individuals aracters are the most striking; and to transitions of doubtful and ill-defined s: for the principle established in bo- considering as belonging to the same ndividuals between which we observe ate shades, cannot be admitted in mi- without reducing all known fossils to single species. Indeed there is none not be departed from, to make the tour le chain of those which have already rmined, by almost insensible shades; nore we shall study mineralogy, the truth will become obvious, by the f varieties and shades that we shall

efore say, that when two fossils pre- kable differences, we must not refrain nguishing them, and giving them dif- nes, under the pretext that we have rmediate varieties which seem to con- , by appearing to belong equally to d the other; without which, I repeat, nall no longer distinguish genera nor

species; there would be but one and t
name for all the mineral kingdom. Thus I
tinguish granite from porphyry, porphyry f
trap, this from petrosilex, *roches*
argillolites, because the well-cl
viduals of these different kinds are e
distinct; and I do not embarrass myself
there are transitions or intermed e
which I do not exactly know to
ought to refer.

"I have in this only to regret a.
from the acceptation that M. Do
given to the name of *trap*, in the ex
he published, *Journal de Physique*, An
page 257. He had given this name to
neus trapezius of Wallerius, which
stone of the genus *cornéennes*, wi
compact fracture. But I have already
in another place, that the genus of
néennes does not require this subdivis
the class of composites or rocks ap
pable of avoiding it; and of the t
brated Werner has even formed s h
where, under the head of *trapp fo*
includes *grunstein*, the *amygdaloïde*,
phyrschiefer, and *bazalt*.

"I shall also observe, that the
the name of *trap*, not only to a si

ven definition at the beginning of

6. T traps forming the cement of dif-
ariolites of the river Emme, vary in their
and nature. We see some of them grey,
pproaching to green, and others to a
lour; they are more or less hard, some
ing only in their glands free calcareous
thers contain in their paste some which
friable after having remained in the ni-
id. Even the cement hich uni the

of those which compose the substance of traps, and not of the large grains or glands which form amygdaloids, these little grains, I say, are of quartz, felspar, sometimes of hornblende, and of that substance I have called granular chusite, § 1944[*].”

Volcanoes.

According to the present classification, genuine basalt, that of the ancients, must be omitted in the dispute between the Neptunists and Volcanists, which only regards basaltin. The common trap of the Swedes and Germans is always a basaltin; and when stratified is allowed even by Faujas not to be volcanic. The contest therefore chiefly relates to the columnar basaltin, which the French mineralogists infer to be always of a volcanic origin; while, as already observed, it seems rather to arise from a phenomenon still more grand and rare. The great chain of volcanoes in the Andes is chiefly argillaceous, or clay porphyry; and their most dangerous ejections are torrents of mud. In New Spain, where the mountains are chiefly of clay-slate, a volano suddenly burst out in the vale of Jorullo, 1759; when, according to Humboldt, who saw t in 1803, a basaltic cone appeared above ground, of 1400 feet in height: but this cone seems rather to have been developed than ele-ated by the new volcano, as it could scarcely e formed from fluid lava, which would be con-radictory to the common laws of hydrostatics. The accounts of the volcanoes in the Andes are far from being complete; but there seems to be ittle or no mention of basalt, and no hint of ba-saltic columns; which, if they were volcanic, would be truly surprising in a chain which ex-ends more than three thousand miles, and con-ains about a hundred active volcanoes.

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[*] Sauss. vii. 203. For the chusite of Saussure, see his J
to the extinct volcanoes of Brisgaw, *Journ. de Ph.* 1794, p.
See also his account of *pierres de corne*, § 95: most of
be scratched by the nail. He says, § 103, that trap is a c
pierre de corne, which not being a production of fire, is very d
from basalt. In § 1525, Saussure doubts if the basaltin
extinct volcano of Beaulieu be volcanic.

But as the presence of iron seems necessary to volcanic inflammation, and the same metal forms the ruling ingredient of basalt, it is no wonder that this coincidence should have occa-ioned a confusion of ideas. Around the grand rolcano of the isle of Bourbon, there are basaltic rocks; and where the basaltin contains sulphur, it may be presumed to be a compact lava; but here are no ranges of those grand basaltic co-lumns which distinguish Faroe, or Staffa. If we return to Europe, the grand volcano of Etna has probably been in a state of conflagration for 2500 years, and the circumference is computed to extend to one hundred and thirty miles; yet, among the numerous hills which surround this sublime volcano, there is none capped with basaltic columns; and its lavas, after such numerous ejections, do not seem even accidentally to have assumed those elegant and precise forms*. Dolomieu, and other prejudiced Volcanists, have indeed observed instances of the lava divided into rude prisms; but where is the representation of any Giants' Causey in Sicily? Where the base of Etna reaches the sea on the east the shore is volcanic, or at least supposed to be so, for the space of twenty-three miles; and for the first seven or eight miles after leaving Catania, Spallanzani indeed observed some prisms, more or less characterised; but the two other thirds of this shore, though equally consisting of lava, only present irregular fissures. It is presumed that even the former bear but a slight resemblance to the beautiful articulated columns of Staffa, or the Giants' Causey, especially as figured by Da Costa and Pictet. It is also to be questioned whether these columns of Etna be not composed of porous lava, as Dolomieu allows that some are, while others, as he says, are compact, because the water stops the internal effervescence; and whether, if the observers had seen the elegant articulated columns of the north of Europe, they would not have rejected the comparison *? But as Sicily may be said to be in our possession, and the interesting work of Dolomieu has not been translated into English, it may not be irrelevant to present an extract, that future observers may decide whether the appearances be caused by the eruptions, or be antecedent to them.

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* Von Troil has observed, that basaltic columns are common in Iceland; but the people suppose their ranges the work of giants, while, if they originated from the volcanoes, the circumstance would strike the most common observer. They sometimes appear among lava, sometimes among tufa; that is, they are preexistent to either.

Basaltin of Etna.

" As basaltic columns rarely appear in cabinets, and it is more interesting to see them on the spot, that their groups may be the better followed, I shall point out those parts of Etna where the most curious phenomena of this kind may be observed.

" In the second of the Cyclopic isles, of which the form is that of a long pyramid, immense prismatic columns, perpendicular, articulated, and for the most part hexagonal, appear; the diameter of which is from two to three feet.

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* I have seen, in the beautiful collection of M. Patrin, at Paris, berils articulated in the same manner with basaltin: but no one has supposed that berils are produced by fire.

"In the two other Cyclopic isles there are smaller columns, heaped upon each other, or inclined in different directions.

"Upon the shore of la Trezza, near the pier, there is a very curious group of little articulated columns, which radiate from a common centre, and form fasces singularly contorted; the articulations are marked, but the vertebræ, so to speak, do not separate.

"Upon the shore between the castle of Iaci and la Trezza, there are many groups of basaltic columns, piled in various ways.

"At the foot of the mountain of the castle of Iaci, there are many groups of pyramidal divergent columns.

"In the body of this mountain there are large bowls, from two to four feet in diameter, like the large balls of pyrites found in chalk, being formed of pyramidal columns united by their points in a common centre.

"In the mountains of la Trezza is found a great number of prismatic columns, of different forms and dimensions, many being displaced and lying in the clay.

"At Iaci Reale, at the bottom of the cliffs on the sea shore, are seen large prismatic columns, subdivided into many smaller; while on the shore there are many large prismatic columns rising from the sea, the tops forming a walk at the bottom of the cliffs.

"In the mountain of la Motta, two leagues from Catania, there are very large and long prismatic columns, in a vertical position, formed of the most compact lava, which rings like bronze.

"In the mountain of Paterno there are large columns, ill figured.

"In the mountains of Licodia, near the spring called Capo del Acqua, there is a wall of large prismatic columns.

"Under the little town of Bianca Villa there are cliffs formed by prismatic columns.

"In going from Bianca Villa to Aderno you often walk on the tops of columns, which form regular pavements, resembling the ancient Roman ways. Within the town of Aderno there are also several basaltic causeys.

"Between Aderno and Bronte, on taking the lower road which follows the course of the river, you walk for more than two leagues on a pavement formed by the tops of columns; and on the right are the most beautiful walls of prismatic basalt which I have ever seen, the columns being mostly vertical. There may also be observed in many places fasces of prisms, projecting from the wall, like epaulements or demibastions. The columns reunited by their summits, as into one head, enlarge according to their length.

"Scattered prisms and walls of prismatic lavas may also be found in many other places; forming, as I have already mentioned, a kind of belt around the skirts of Etna. Don Joseph Gioeni, whom I have formerly celebrated, is occupied with an elaborate description of the prismatic lavas of the volcano; and he will add prints which can alone express the variety of their forms, and the manner in which they are grouped*."

If these representations be exact, they would certainly induce us to believe that prismatic basaltin is the product of volcanic fires; and an admirer of nature would willingly embrace a new and important discovery, which would afford greater variety to his views, and more striking topics for his contemplation. With regard to the British dominions, in particular, a volcano, even extinct, might be regarded as a grand and curious acquisition. The great number of volcanoes which exist, or have existed, in Iceland, the southern skirts of which can alone be said to be known to naturalists, might well authorise us to believe that a chain of volcanoes may have existed in a tract of country, or isles, between the north of Ireland and Faroe, and which have been submerged, the foundations being destroyed by the violence of their own conflagrations, and the fury of the Atlantic ocean. There are indeed, according to Landt, evidences of a vitreous lava in one of the isles of Faroe; and my intelligent friend Mr. Browne, who has penetrated so far into Africa, and has pervaded many parts of Asia and Europe, was convinced that he observed a wall of porous lava near Belfast; but still there is no appearance of any craters. Perhaps a disciple of Dolomieu, certainly a great and respected name, "*clarum et venerabile nomen,*" would be contented with one enormous volcano between the north of Ireland and Staffa, and another among the Faroe isles; for the exterior chain of the Hebudes is granitic, as are most of the Shetland islands; while the Orkneys consist of argillaceous sand-stone; and none of them can, on any theory, be said to present volcanic appearances.

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* Dolomieu, Etna, p. 455. It must not however be forgotten that, p. 192, he allows that all these columns present small pores, visible by a lens; nay, p. 180, he regards all lavas as compact which contain spaces of some inches without pores. But he might say, as compactness is owing to refrigeration, that, in the cold and moist regions of the north, lavas are more compact.

However this be, as the genuine basalt, that of the ancients, is allowed on all hands not to be of a volcanic nature, the distinct name basaltin becomes the more necessary, in order to discriminate a wholly different substance, the origin of which is still liable to contestation.

Concerning basaltin, by many called c
lava, further observations will be f
cussing the Volcanic Rocks. The
Daubuisson, concerning the volcanic o
this substance, is too remarkable to
as in his able treatise on basalt he
enforced the contrary opinion, e
he was at Freyberg, and enveloped in
of Werner. This change of his Nep
occurred after his visit to Auvergn
which presents many extinct vol
who have seen it or its products
this curious fact being only denied by
are lost in the mist of prejudice, and
ruin their own system, by pushing it
maintain tenets palpably absurd, and
tory to the common sense of manki ;
for example, that pumice itself is of
origin! The following abstract of
remarks on Auvergne is given in the
*Physique**.

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* 1804.

"After having given a preliminary idea of the topographical position of Auvergne, and the mineralogical structure of this country, M. Daubuisson has successively and in detail described the volcanoes and basalts of the country of Puy de Dome, Mont Dor*, and of Cantal, he concludes his memoir by a general review of his observations. We shall here give an extract from this latter part.

Daubuisson's opinion.

"Auvergne (Departments of the Puy de Dome and of Cantal) is in the middle of that great slope, or inclined plane, whose bottom lies towards the center of France, and which terminates in the upland that directs the course of the Rhone to the westward. The primitive soil (anterior to the volcanoes) is of granite, covered in some places with a marly limestone. The valleys excavated in this soil render the country unequal, and give it a mountainous appearance, although there are in fact only excrescences or volcanic mountains, which rise above the general plane of the slope.

"Nearly all this soil has been covered with volcanic productions: they are of three kinds, and their formation seems to date from three distinct epochs. The most recent and least numerous are currents of lava, which lead to craters still existing; the second are masses or tables of basalt, separated by rifts or valleys; the third consists of mountains whose mass is a kind of volcanic porphyry.

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* This is the proper spelling, derived from the river Dor, which, joining the Dogne, forms the Dordogne. See Le Grand.

"1st. *Lava in form of currents.* There are in Auvergne near a hundred conical, isolated mountains, from 200 to 400 yards in height, formed of heaps of scoriæ, fragments of lava and of lapillo: their summit often presents a hollow in the form of a cup or crater: they rest ne-
diately on granite. From the bottom of e
of them currents are observed to run of
basaltic nature, that is of a greyish k,
a fine compact grain: this lava con
and crystals of peridot (olivine), aug
&c. The superficies is blistered and
with asperities, which sometimes attain
surpass a yard in height: the inte r
compact, and less porous, as you arri
to the bottom. The currents are spr
adjacent plain; they have sometim r
the bottom of certain valleys, and have
their course for a distance of three
leagues; in advancing progressively t
incline to points lower and lower; they
the inequalities of the soil; they sepa
meeting with any obstructing eminences in

passage. In fact, like the courses of fluid matter, they have been subservient to all the laws of hydrodynamics. The history of these currents of lava is complete, and there is nothing left to the imagination to supply. We behold the orifice from whence they issued, the course they pursued, the country they occupy, &c.

"They flowed upon granite: their substance then was either in or under that rock; now these lavas contain from 15 to 20 per cent. of iron; the granite possesses scarcely any; they do not therefore consist of granite, fused and wrought by volcanic agents: we must therefore, with Dolomieu, seek under this rock, for the matter which has yielded this substance; but here we can only form conjectures. The cause which may have developed this subterranean fire, the combustible matter which may have maintained it, are entirely unknown to us. It is not coal, or bituminous matter, for they are only found in secondary regions, and never either in or under granite: it does not consist in pyrites, because pyrites, alone and enclosed in the bosom of the earth, never decompose, and generate no heat. As for the period when these lavas flowed, although anterior to the history or tradition of mankind, it is nevertheless very recent when compared with those vast degradations which

the surface of the globe presents: it is
to the entire excavation of the valleys,
occupies their bottoms.

"2d. *Basalts.* The volcanic
the second kind, are basalts, which,
form of sheets, tables, peaks, cover t
parts of the ancient soil, or constitute
mit of some mountains and isolated e
they are also observed on almost all
Mont Dor and Cantal; they are evi
the remains and patches of different
which have spread over the c
sent the same mineralogical c
basalts of other countries, Saxony,
contain the same substances; they
cline to a prismatic division; they cover
distinction all kinds of rocks, and
covered by them, &c.

"A volcanic origin cannot be
basalts. The perfect resemblance
paste and that of some parts of curr
which are found in the neigh
which have come from a crater still
already a very strong presumption;
present other infallible marks of
1. In following step by step cert
basalt which are near Mont Dor
and supplying by the imagination w

n taken away, you arrive at the sides two enormous volcanic mountains, and ie to masses of scoriæ or of blistered here, beyond doubt, we are near the the current; all the basalts which have owed upwards, made part of that cur- A great number of those large basaltic which cover isolated mountains, dis- heir surface blisters, spongy scoriæ, or like those which are observed on the erved lavas; nor can we refuse them a igin. Some others of these platforms n volcanic ashes. 3. Some isolated s present, it is true, summits of black mpact, prismatic, destitute of those un- l signs of the action of fire which are seen e; but the greatest part of them stands de of those platforms with scoriated sur- which we have just spoken: they once ith them a continued whole, and have only been divided from them by the on of the valleys and ravines which now them. They cannot have had a differ- n; the corrosive action of time and the must have destroyed the scorified bark; compact nucleus would remain, de- the marks of the action of fire, as are ior parts of the greater portion of lavas in currents. Thus all the basalts of Auv present proofs, either direct or indirect, of a canic origin; though the degradation of soil, the dismemberment that the currents l suffered, no longer permit us to retrace the ter from whence they flowed, nor to see number, form, or extent, of the different rents: the only positive thing we can regard to them is, that their existence to the excavation of the valleys.

"3. *Porphyroid Masses.* The thi of volcanic productions of Auverg a peculiar nature; they are grey of a porphyritic structure; they f n ten distinct mountains: the most c are Cantal, whose diameter at the about nine or ten leagues, and 900 or 1 high, above its bottom; the Mont D r, base is five or six leagues, and its 1000 to 1100 yards; the Puy de D base is half a league in diameter, and y high: the other mountains are still two first are vast masses, torn and irr cut by the action of the waters. The of which they are all composed is grey, approaching to black, sometimes to gre fracture dull and earthy, with coarser grains; it has little hardness, and easily poses; its weight is about twice and a half greater than that of water; it melts easily under the blowpipe into white amel*, and seems to be composed of the same elements as felspar, but confusedly united; it contains a great quantity of crystals of felspar, some acicular crystals of hornblende, and even some spangles of mica. The klingstein-porphyr of the Germans†, which is found in considerable quantity at Mont Dor and Cantal, seems to be only a remarkable variety.

"These porphyroid masses so nearly resemble certain productions in the humid way, that it required nothing less than their extraordinary position, their situation in the midst of volcanoes, some unequivocal marks of the action of fire, their passage direct or indirect to basalt, and above all the volcanic scoriæ imbedded in their mass, to prove that they are foreign and posterior to the productions in the humid way, and that they owe their existence to the volcanoes.

"Nothing positive can be said as to the manner in which they have been produced, and arrived at their present position. No where is there observed any crater from which they c have issued, nor distinct currents by which might be traced to their origin. It mig thought that they consist of melted g wrought and ejected by volcanic agents. T homogenity of their paste shows how c the fusion or igneous dissolution has a, scarcely permits one to believe that t of crystals of felspar which they c , have pre-existed the fusion, and itl The form of these crystals, their lamir st ture perfectly preserved, their t y, their facility of melting, their n in these vast masses, and in short th r of composition with the paste which s them, leads one to believe that they during their igneous fluidity, by an mation of their integrant parts, which to obey the laws of their affinity. T phyroids are the most ancient of all the productions of Auvergne: they are cove basalt, and contain veins of that subs

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* See Johnson. Enamel is properly the application of the amel to another substance.

† Klaproth procured 8 per cent. of soda from that of Bohemia, and Mr. Bergman 6 from that of Mont Dor.

"However different these product be, however distant the various peri s of formation, they do not seem the less united certain degree, and form, in some sort, an system. Cantal, Mont Dor, Puy de Dome, the most ancient of the volcanic ma a direct line, running nearly from south to north. Almost all the basalts of these regions, that may be, in some manner, retraced to their origin, seem to have taken their direction in this same line. It is also in this direction, and among the ancient products, that the greater part of the craters have opened, whose vestiges are still visible. When at two leagues to the westward of Clermont, we see near sixty volcanic mountains, ranged in a straight line, one can scarcely believe it to be the effect of chance. A cause has certainly existed which has produced this effect: perhaps there was under-ground, and in this direction, as it were a vein of matter which contained the germ of volcanic fire, or which was of a nature to maintain it; the cause always existing, its effect might have been renewed at different periods."

These observations are no doubt cogent, and worthy of the acknowledged ability of the author. But in the spirit of perfect candour when treating a subject where it is difficult, after every allowance for the weakness of the human mind, even to suppose that prejudices should exist, Brochant's able abstract of the arguments for and against the volcanic origin of basaltin, shall here be subjoined, as the author thinks it a meritorious service to the science, to lay before the

English reader interesting extracts from such works in the foreign languages, as, from their very nature, can scarcely be expected ever to be known to him by translation.

Brochant's statement.

" It has already been said in the Introduction, p. 68, that mountains of secondary trap, and chiefly the basalts, were looked upon by some mineralogists as produced by volcanic fires, while Mr. Werner, and almost all the learned men of Germany, are of opinion, that they have been formed, like other rocks, by the waters which inundated the surface of the globe.

" The former ground their opinion on the following reasons.

" 1. In the masses produced by volcanoes which have burnt in our time, are found prismatic basalts, and other rocks which resemble trap, and which nevertheless bear no character of fusion, and which only the locality and position indicate as volcanic.

" 2. It is an error to believe that all the masses ejected by volcanoes must be vitrified substances; such are on the contrary very rare.

" 3. Neither is the black colour essential to volcanic products: there are some grey, others brown, and even white.

" 4. Many observations have proved, that the fire of volcanoes is very inferior to that of our furnaces; therefore it is not surprising that baalts may be changed by an artificial fusion; and t is no reason for believing that they have not before undergone the action of volcanic fires.

“5. Even supposing that volcanic fire posesses a great heat, it is known, by the beautiful experiments, made in England by sir James Hall, comparatively on the whinstone*, and on the lavas of Vesuvius, that a contexture and aspect may be given to a rocky mass, melted and cooled, which shall have the characters of glass or stone, according as the cooling is quicker or slower. These experiments having been repeated on several kinds of whinstone, there has always been obtained by a gentle cooling, a stony mass, compact, dull, exactly similar to the whinstone employed; and on the contrary, a vitreous mass was obtained by a rapid cooling. The same essays made on the substance of bottle glass, gave the same results.

“We see then that the absence of scoriæ and vitrifications is not a reason for denying the volcanic origin of basalt; besides, it is a known fact that burning volcanoes have produced it.

“ * The whinstone of the English is generally a secondary trap; but among several specimens that I have seen given under that name, some resembled basalt, others grunstein; others in fine had the structure of amygdalite.”

"6. But without mentioning basalts, which have so many volcanic characters, a great analogy is found between secondary mandelstein and porous lavas; between the clay of trap mountains and the products of muddy eruptions; between basaltic tufa and volcanic tufa; and almost all minerals which are found scattered in volcanic masses, are found in trap mountains, &c.

"7. The position of secondary traps, which lie over all secondary rocks, while the hardness, compactness, and other characters of many among them, such as grunstein, basalt, and others, are so different from those of the secondary rocks on which they lie. That kind of dryness to the feel which they present, and which is characteristic of volcanic productions in general, all these approximations will not permit us to acknowledge that basalts have had the same origin as all secondary rocks.

"8. It has been objected that in basaltic countries basalt is found on almost all the summits, and that such would not be the case, if basalts were lavas: this might be true if these lavas proceeded from a recent deposition; but on the contrary this deposit seems very ancient, and has undergone many changes. M. Reuss himself observed in Bohemia, that the basaltic summits he there met with, seem to be the remains of a vast bed of decayed basalt.

"9. In short, the conical form of trap mountains, and above all those of basalt, has the most perfect resemblance to that of volcanic mountains; and it is this resemblance which gave the first idea of attributing a volcanic origin to basalt.

"The advocates for the formation by the humid way, or the Neptunists, on their part support their opinions by many observations, of which these are the principal:

"1. It is true basalts are found among products of burning volcanoes, but they are extremely rare, and modern eruptions have not produced any.

"2. Whatever origin may be attributed to the division in prisms, tables, &c. it is not peculiar to trap rocks: there are gypsums, marls, sand-stones, which frequently offer this structure. Thus then this division in prisms, very rare among real volcanic products, on the contrary exists in many stratified rocks.

"3. Basalts often repose immediately on coal, as at Meissner, near Cassel: now, if this basalt was volcanic, it must necessarily have produced the combustion of these beds of coal.

"4. The remains of vegetables and animals, which are found in some trap rocks, could i in like manner have resisted the volcanic without being destroyed.

" It is the same with many minerals wl are very fusible, and which are there met indeed, some are also found in volcanic r but these instances are rare, and cannot a basis to a general rule.

" 5. Cavities filled with water, such hydritic agates found near Vicenza, in I y, secondary trap mountains, entirely d supposition of a volcanic origin *.

" 6. There are not observed in trap ro that black colour, or those indications vit faction, that are apparent, at least in certain tions, of the products of burning volcanoes: n craters have never been observed. All th which have been cited were hollows, cl filled with water, so common in so tains.

" 7. Mandelstein has certainly some r blance to porous lava; but there are n steins evidently not volcanic. B t cavities of the mandelstein of trap moun contain very different minerals, and which c

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" * The Vulcanists answer that these agates have a latter from infiltration."

not have undergone the action of fire without being changed*.

"8. It is true, that according to the experiments of sir James Hall, and some late observations made upon burning volcanoes, it is known that rocky substances may, after fusion, reassume their stony character; but when this takes place in burning volcanoes, there are always found in the vicinity substances which have not experienced this effect, and which on the contrary are scorified or vitrified; which denotes the action of fire.

"9. In different countries, and especially in Bohemia and the Vicentine, beds of basalt have been observed, which alternate with grit, or stratiform limestone: does not this reunion of these two rocks prove that they have had the same origin? The Vulcanists, to make this agree with their theory, are obliged to have recourse to quite a forced supposition, according to which there have been alternately volcanic eruptions and submarine deposits; whereas this alternation of beds of different rocks, of nearly contemporary formation, has more than one example in mountains.

"10. There are many basaltic regions where

"* The same observation as in note upon article 5."

basalt is only found on summits, and it is dently perceived by the correspondence of beds, that all these summits were parts of and the same bed, which spread over l country: now, that is not the nature of v deposits; they form currents, which take tain direction, and no similar examples vast deposits are known, but among rock duced by water, and particularly among form rocks.

“ 11. Basalt has no appearance of heated in a furnace it melts to glass. It that from Hall's experiments, a stony has been obtained; and that may very pen, since nature produces it in l canoes. But these cases are very rare, I has justly observed, that in his experi its appearance depended on the manag nt of cooling: but it must then be supp circumstance is always met with in eruptions, which are supposed to have produ the mountains of trap.

“ 12. The prismatic division of t been attributed to the water of the sea, they say then covered all the region upon these lavas have run: that is possible; but accelerated refrigeration should, according Hall's experiments, give the lavas a vitre appearance; which is not the case even in portions of the mass.

"13. The conical form of basaltic mountains proves nothing; it is true, that such is the form of volcanic mountains, but in general it is that of all mountains whose sides are covered with earthy substances. Melted substances, ashes, give this form to volcanic mountains; and if basaltic mountains assume also more particularly this appearance, it is because their fragments are quickly reduced to this earthy state, so that they naturally form slopes on the sides of mountains.

"Moreover, the conical form of basaltic mountains is not that of burning volcanoes: the former are cones, isolated one from another, nearly equal in height; whereas volcanic mountains are grand coniform elevations, whose slopes and sides are loaded with little conical summits.

"One might extend much farther this chain of motives on which both theories are founded, but longer details would be here superfluous*;

"* It may be observed, that the points of division are often in matters of fact; as the existence of scoriæ, vitrifactions, that of craters, &c. I do not pretend to discuss their legitimacy.

"Perhaps both parties may think that I have not done justice to their arguments, and that I have overlooked some important ones. I believe not: I endeavoured to reconcile them, at least the principal; but I confess if any have escaped me, I should easily console time may perhaps some day afford tl solution of this great geological prob] lomieu occupied himself much upon it; doubtless would have succeeded in uniting parties, if death had not overtaken him midst of his labours. He adopted neit r two opinions: he was persuaded that h admissible, according to localities; be ing often seen in the products of the volcanoes of Italy, rock entirely rese ng salt, and even other primitive rocks, found by long experience, that only the ters of locality would decide on the of either. He had, according to this observed some basaltic countries, ar Auvergne and the Vicentine, and he l garded them as volcanic. I chiefly cite two examples, because I know that n brated German mineralogists are of opinion*."

A yet later French mineralogist has thus pressed his sentiments upon this curious long-agitated subject.

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myself, if I thought that would induce the opinions to publish fresh memoirs, to undertake tl own This great quarrel has been long hushed, and pro ly I have collected new observations."

* Brochant, ii. 612.

shall give a third opinion upon the ori- salt, in a medium between the two pre- nes, and which appears to us the most . The naturalists who profess it, as lomieu, Delrio, Spallanzani, think that ssion on basalt is often a dispute of ds: that if this name is given to those ose characters we explained at the be- f this article; some are truly volcanic, ers have entirely an aqueous origin; asalts of Saxony, and those of Ethiopia, belong to this second division, and that ble that those of Scotland and Ireland g to it; while those of Italy, and Au- ould be arranged in the first class to- t least in part.

Brongniart's idea.

naturalists, and particularly M. Patrin, hat basalts are the productions of the uptions of submarine volcanoes; and ature of the eruption, and the influence er, have given to this lava those par- aracters for which it is remarkable. eve that the latter influence prevented tic matter from calcining or burning stances on which it flowed. This hy- which seems one of the most probable, lied without exception to all basalts, vell enough the alternation of beds of

prismatic basalt with beds of
and earthy matter without
same beds of basalt with
bonate of lime, or with coal, ich
altered by it; in short, the pr
shells in some basaltic beds.
in this hypothesis, concurred
prismatic basalt, no longer existi
basalt is no longer formed in those
of lava which in our days have issued
canoes. It seems that it is with
veins, crystallised beds, fossils pr dy
&c. Nature in her present qu
longer forms any*."

The extent of these observations
doned, as there is not, in this
more difficult or interesting: b
return to a more immediate v
brated substance.

STRUCTURE I. AMORPHOUS.

This rock, as already mentioned, is the
the Swedes, who first recommended it to
notice; while the basaltic columns of Sax

---

[*] Brongniart, i. 473. He had observed, p. 470,
ing the sea becomes fixed on the surface, and
columnar form, which rather proceeds from slow

served by Agricola, the restorer of mine-
in the sixteenth century. Whatever be
igins, these two substances are identically
e; as the same results may be produced
y the humid or the dry processes of che-

:t 1. *Uniform.* The columnar basaltin
already mentioned, attracted great atten-
the beauty and regularity of its forms, as
the sixteenth century; but trap, or stra-
l basalt, may be called a discovery of the
. The hill of Kinnekulla, in Westrogothia,
e of the first observed; and also that of
erg, in the same province.

k basaltin, from Kinnekulla and other parts
den.

y basaltin, from the same.

nish, from Norberg.

lish, from Sweden.

k basaltin, with small needles or scales of
, from Sweden.

tified basaltin, from Faroe, Staffa, the
' Causey, &c. where it sometimes underlies
umnar.

same, from the castle hill of Edinburgh,
rton, and other parts of the south of Scot-

The same, from Andernach on the

The same, from the Sierra Morena, Mountains, in Spain.

The same, from Toplitz in Bohemia.

Black basaltin, from Egypt.

Green, from the same.

Red basaltin, from Channelkirk in Scotland.

Brown, from the same.

Stratiformed basaltin, from Saxony.

The same, from Etna, Vesuvius, t Bourbon, New Spain, and other v gions*.

Aspect 2. Mingled. Basaltin, of steatite, from the isle of Skey Westrogothia, &c.

Black basaltin, with red zeolite, fr

The same, with white zeolite, from Causey, &c.

The same, with many beautiful v lite, from the Faroe isles.

The same, with zeolite, from Etna, &c.

The same, with grains of pyrites, from berg in Sweden, Dauphiny, &c.

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* Saussure mentions, § 1497, a kind of called laminar: and, § 548, a singular r *de corne*, in thin leaves, with mica, quartz, and If says, it would have formed a genuine po ry.

The same, with nodules of calcareous spar, in various parts.

The same, with red jasper, from Derbyshire.

Basaltin, passing in veins through granite, from rway. With inherent pitchstone, from the ine.

Aspect 3. Basaltic Tufa. This substance has n observed at Staffa, and in some other basaltic ntries. A considerable portion of Arthur's , near Edinburgh, is composed of it.

Aspect 4. Basaltic Bricia. Bricia, with fragts of granite, on a base of basaltin, either k, grey, or green, from Westrogothia in Swe-, or from Dauphiny in France.

The same base, with fragments of quartz, from same.

he same, with fragments of limestone, from Alps of Dauphiny.

he same, with fragments of slate, from the e, and from the mountain of Tarare, near ns.

he same, with fragments of granite, slate, and stone, all mingled, from Tarare, and Dau-y.

e same, with fragments of porphyry, from ill of Lesterelle in Provence.

Bricia of fragments of basaltin, joined cement of quartz, intermixed with particles basaltin. Uncertain.

STRUCTURE II. COLUMNAR.

Basaltin of Stolpen.

Aspect 1. Uniform. Basaltin, from S in Saxony. Remarkable as having att l th attention of Agricola, and other naturalists the sixteenth century. The little town of Stolp is built upon the side of a basaltic hill, a fe miles to the east of Dresden. The lower part the hill consists of a granite, of white grey quartz, and black mica, upon salt reposes, presenting the most b regular columns observable in Germany have commonly six sides; but so e five, seven, or eight; yet their le th seem to exceed fifteen or sixteen feet. T lumns are vertical; but on the south there a rock of stratified basalt, of that ki pears in thin plates or tables. T Stolpen is black with a bluish cast, the g b impalpable, the fracture conchoidal, and ments sharp. Its hardness, like that of and basalt, equals that of iron the har being more than 800 of Quist's gradation.

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* Daub. sur les basaltes, 42.

basaltin often presents little cavities, lined with chalcedony, and quartz crystals; sometimes filled with green steatite, calcareous spar, zeolite, or a lithomarga, resembling semiopal. Small grains of olivine also occur, and dots of siderite, or perhaps augite. The pillars are used for many useful and ornamental purposes of architecture; an example which might be followed in other basaltic countries, with a sacred regard however to the more regular, grand, and conspicuous parts.

Columnar basaltin, from Italy, Sicily, Auvergne, Hungary, Bohemia, Saxony, Lusatia, Thuringia, Hessia, Goetingen, Nassau, in Germany; from the isle of Bourbon, New Zealand, and other isles in the South Sea, &c. &c. The columns are often so small as to be chosen as specimens.

Aspect 2. Mingled. Columnar basaltin, mingled with zeolite, from many countries.

With nodules of steatite, calcareous spar, chalcedony, lithomarga, olivine, &c. from Stolpen, and other places.

MODE IV. BASALTON.

Characters. Texture coarse, and of a large grain, mixed with quartz or felspar, but lax, and incapable of the fine polish of basalt or basaltin.

Hardness marmoric. Fracture commonly even. Fragments blunt and amorphous.

Weight sometimes siderose, generally granitose.

Lustre glimmering. Opake.

Colour grey or greenish.

Name. As the Italian termination *ino*
minutives and substances of a finer
that in *one* is employed to discrimi
a coarse appearance or large grain.
name *basalton* is adopted for another
the basaltic family, that called *grunst*
Germans, an appellation alike vague
barous, as are most of those terms
the vulgar miners. The most im
beautiful of the grunsteins, a mixture of
lised siderite with felspar, has been alr
scribed after siderite. By basalton are u
Coarse grunstein. stood the other kinds of grunstein, exce
porphyries; being a mixture of coarse
without the splendour or cohesion of that
stance, with either felspar or quartz. Even t

with a finer grain must still be regarded as a coarse rock, as it does not admit the polish of basalt or basaltin. The common whin-stones of the north of England and of Scotland belong to this class. It is unnecessary to indicate many examples of so common a substance, which is chiefly interesting from its intimate connexion with basalt and basaltin, often passing either nto the one or the other of these substances.

Werner has considered grunstein as either rimitive or stratiform. The former has been ere described under the venerable name of Wallerite; the latter, which commonly covers he beds of basalt, is that about to be mentioned. t would appear that he has since added a trans-tive grunstein, distinguished by veins or grains f quartz, in Voigtland called *leberfells*, or li-er rock, being coloured with a reddish brown xyd of iron. This transitive grunstein occurs the Hartz, in Bohemia; and, according to r. Jameson, in the upper part of Dumfries-ire. The Wernerians regard grunstein as a ore chemical solution than basalt, though it mmonly rest upon the latter; while in general more chemical dissolutions are the lowest: ircumstance which they endeavour to ex-in by supposing the superincumbent waters e agitated at one period than at another.

STRUCTURE I. COMPACT BASALTON.

Compact basalton, from some of tl pillars of Stonehenge.

Basalton, or whin, from Salisbury (Edinburgh.

The same, from the Malvern hills.

Basalton is common in the pavement of l

STRUCTURE II. SLATY BASALTON.

Grunstein slate.

This is the green-stone slate of t Ge being composed of siderite and com t or felsite, which is sometimes more al it t the former. It is said to form mountai Sweden, and abounds near the mines of Ad being often metalliferous. If the felsite gener exceed in quantity, it ought to be classed un that rock.

Klinkstein.

The porphyry slate, or clink-stone porphyry, Werner, *basalte en table* of the French, seems intimate mixture of iron and felsite, and found in basaltic countries. It has been by Klaproth, who found eight parts of s hundred. How it came to be classed a basaltic family can scarcely be imagined, from its local situation, a circumstance ponderant with Werner; it being as often in the vicinity of basaltin, as lava with a base felsite is in that of lava with a base of siderite. It is surprising that the French mineralogists have not adduced this circumstance in favour of the volcanic origin of basaltin. Clink-stone however has no sort of relation to the family of basalts, as the chemical analysis infallibly demonstrates; for it only contains 3 in the 100 of iron, while all the other modes present more than 20. It is therefore here classed under Felsite, with which the analysis strictly corresponds, except that there is double the quantity of iron, which imparts the black colour.

MODE V. PORPHYRY.

Name.

This rock belongs to the division here called *Intrites*, as consisting of crystals or grains imbedded in a base or paste, in contradistinction to Granites formed by simple coherence, and to Glutenites, (both also derived from the Latin), in which the particles are cemented together by the same or by a different substance, scarcely visible, or at least not so abundant as in the Intrites[*]. This last denomination, besides instantly recalling to memory the nature of the rock, would prevent the misapplication of the classical term porphyry to many substances, which have only a very faint and distant resemblance.

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[*] In like manner the Glandulites of Saussure are those stones which include glands or kernels.

The term porphyry is therefore here restricted to its proper and peculiar sense of a base sprinkled with crystals of felspar. The word in the Greek implies a purple, or rather red stone; and in severe classical precision ought to be confined to that colour, common among the monuments of antiquity: but as denominations derived from colour, the worst of all distinctions, have been forced to be extended, the black, the grey, the bluish, and even the green, having the same base of trap or basaltin, must be included. But the base being the sole ground of the present classification, all the other kinds are considered as Intrites, and reserved for separate descriptions.

Base. It was long imagined that the base or ground of porphyry consisted of jasper; but this supposition has been finally rejected, and it has been found to be trap, from its fusibility and other chemical properties, and likewise from its external attributes. Like basaltin, it presen
tals of siderite, grains of quartz, and sc
glandules of chalcedony and of steati
last perhaps forms the green matter in S
porphyry. The crystals of felspar are gene

ectangular, but sometimes oval or otherwise rregular. When they are scarcely visible to the naked eye, the substance is here called porphyrin; and when they exceed an inch in size the term porphyron may be applied.

Werner's Porphyries.

Genuine porphyry abounds in many parts of the world, and often forms entire mountains. Like siderite it has been found to alternate with gneiss, and it occurs in a columnar form. Among the defects of orology, and even of the Wernerian theory of formations, may be chiefly particularised the classification of the porphyries, vaguely so called, which are arranged under one head, whether the base be keralite, felsite, pitchstone, or even serpentine, or indurated clay; while felspar, like mica, may be occasionally found in most rocks, and these pretended porphyries ought all to be referred to their several bases. The name has even been extended to ocks with calcareous or other crystals: and as trict definitions form the first foundation of every cience, no argument can more clearly evince he necessity of new and abundant denominaions of rocks, than this confusion of substances f a nature wholly remote; and so frequent and portant, that no geological work can be prorly understood, except the author use much rcumlocution. For to extend the term porphyry to every substance in which small crystals are imbedded, is as absurd as it would be to confound granular limestone with granular quartz; or any other remote substances merely of similar structure, or even aspect.

STRUCTURE I. PORPHYRY WITH LARGE CRYSTALS OF FELSPAR.

Aspect 1. Red Porphyry. This kind is frequent in ancient monuments. The crystals are seldom so regular as those of the next ucture. It is sometimes interspersed with glol finer porphyry, or even of porphyrin.

Porphyry, from Egypt, or the ruins of Rome.

The same, from the Grampian Mountains in Scotland. It chiefly occurs in Glenco*.

The same, from Corsica.

Aspect 2. Black. A fine column of this kind is in the church of St. Prassede, at Rome.

Aspect 3. Green. This has sometimes been called verd-antique, but the proper verd-antique is a mixture of serpentine and white marble. The green porphyry has also been erroneously supposed

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* Which must not be confounded with Glen Cro, not far from Inverary.

e of the Ophites, or snake-stones of
re, and innumerable others, misled me
g the Ophites of Pliny. The passages are:
issimi quædam [marmora] *generis, sicut*
mium viride, cunctisque hilarius. Sic et
m, ac deinde Tiberianum, in Ægypto,
ac Tiberii primum principatu reperta.
iaque eorum est ab Ophite, cum sit illud
n maculis simile, unde et nomen accepit;
maculas diverso modo colligunt; Augus-
latim crispum in vertices; Tiberianum
n convoluta, canitie. Neque ex Ophite
nisi parvæ admodum inveniuntur. Duo
era, molle candidum, nigricans durum.
edit. Brotier, Paris 1779, 12mo.

Ophite.

, c. 22, speaking of stones used for
nortars. *Potiorem ex alabastrite Ægyptio,*
phite albo. Est enim hoc genus Ophitis,
sa etiam et cados faciunt.

passages may be thus interpreted:
e marbles are of a very precious kind, as
of Lacedemon, which is also more cheer-
any of the others. So also the Augustean,
rwards the Tiberian, first discovered in
uring the reigns of Augustus and Tiberius.
erence between these marbles and ophite
in this, that the latter resembles the spots

of serpents, whence its name is derived; the marbles display their spots in a different ner, the Augustean being crisped y while in the Tiberian the white is convolved. Nor can any columns be ophite, except of a very small size. T e two kinds of it, the white being soft, the or grey hard." He then proceeds to both were used to appease head-achs, the wounds of serpents; particularly l ophite named Tephria, because it w lour of ashes; and also called M the place where it was found, being or sparkling appearance.

The other passage implies that " may be made of Egyptian alabastri ophite, for this is a kind of ophite of which they make even vases and larger vessels."

Lucan also has,

> Quam parvis tinctus maculis Thebanus ophites.
>
> " Like Theban ophites tinged with small spots."

Pliny is not very accurate, and it bable that the ophite came from The Egypt, than from Memphis. It must have been wholly remote from green p being probably the Thebaic stone, r l Theophrastus, of a dark colour s nkled olden drops; that is, as Wad explains, a dark llite interspersed with golden mica[*]. The white as probably a spotted marble or alabaster, for he ancients arranged stones by faint resemblances; ut white ollite, or rather massive steatite, is not nknown in Saxony and other countries.

Green porphyry occurs in large blocks near stia, which, as Ferber observes, was the old harbour where the Egyptian ships unloaded[†]: but ll the other ships bound for Rome also arrived here; nor do I find any mention of green porphyry in the memoir concerning Egyptian geology, which M. Roziere presented to me. This porphyry contains crystals of siderite, and frequently spots of chalcedony. Ferber observed the following varieties:

Ferber's observations.

Dark green, with fair green spots; common.

Dark green, with white spots.

Dark green, with black spots.

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[*] Fossil. Ægypt. p. 27. This subject will be further illustrated n treating of the Magnesian Rocks, and of the ancient marbles, where it will be seen that the green porphyry was unknown till the atter times of the Roman empire. In describing this substance, Da Costa, p. 288, justly observes, that there are no Grecian nor Roman relics of it; and he concludes that very little was found even n Egypt. It is now well known that it is not an Egyptian product; but vast masses remain near the port of Ostia, where it was robably left on the irruptions of the barbarians in the fifth century, hen the arts were interrupted and abandoned.

[†] Travels in Italy, 225.

Fair green, or yellowish green, with b

He also mentions a dark green ry, which the trap base sometimes passes of siderite; while the large white crys spar are so numerous, that it mi white porphyry.

It is believed that green porphyry of t ture is found in Ireland, and in Cum also in Norway.

The ancient was probably found in as will appear in discussing, under one p view, the Ancient Marbles in Domain V.

Saussure's statement.

Saussure mentions the :

A porphyry with a base of g h with very small crystals , bules of lime; the presence of t hard a rock being regarded as

A singular porphyry of a ch crystals of blue felspar. § 1448.

Not far from Frejus is a mountain of red porphyry, with some grains of quartz. § 1 3.

At Esterelle, between Nice and F rocks of porphyry, the base being of the wine lees. § 1436.

Porphyries of Durance.

He also gives the following account of t phyries which he observed in pebbles, in of the river Durance, which has been brated for its variolites.

1539. B. "*Green porphyry.* The cement of this porphyry approaches likewise to that of the ophite*; its colour is however less beautiful: it is a green which verges to the deep grey: it likewise assumes a surface less uniform and less soft to the touch. In other respects its fracture and hardness are the same, but it is a little more refractory, and the glass it yields is less hard and opake. The small fragments of this glass are however attracted by the magnet.

"The crystals of felspar which this porphyry contains are, as in the ophite, lengthened oblique angled prisms, of a white inclining a little to green; of an unctuous and milky lustre; their fracture is more compact, and presents thicker laminæ than common felspar.

1539. C. "*Red porphyry.* The cement of this porphyry is of what I call *primitive petrosilex.* In the rolled pebbles its surface is pretty uniform, almost soft to the touch. It breaks into irregular fragments in sharpish angles, almost opake on their edges. Its fracture is scaly with very thin scales, which, viewed by a microscope, appear semi-transparent and whitish, whilst the base is of a pretty deep wine red.

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* By ophite, Saussure, like many others, erroneously understands the green porphyry.

"This cement is more than semi-hard, it easily gives sparks under steel, and may nevertheless be scratched by a knife, the streak being of a rose colour. It melts with difficulty under the blow-pipe into a semi-transparent glass, grey and full of bubbles, mixed with some brown dots, which are attractable by the magnet.

"The grains are of felspar, white, yellowish, rarely crystallised with regularity, and of the unctuous nature of the preceding.

1539. D. "*Black porphyry.* The paste of this is of a fine deep black, approaching a little to blue: its exterior surface is pretty uniform, and almost soft to the touch. Its fracture delicately scaly, as that of the preceding; but its hardness rather less, although it yields some sparks. It is still more refractory; the flame of the blow-pipe only whitens and blunts it a little on the thinnest edges.

"The grains, of a greenish white, have no regularity; they are cemented in the black base of the stone, in all sorts of forms. Their fracture is most frequently scaly: there are however to be seen some marks of the laminar texture of the felspar, and it is also, as in the others, of the unctuous kind.

1539. E. "*Brown porphyry.* Its cement is brown, rough, and of an earthy aspect; it is however pretty hard. The grains, seldom regular, are of an unctuous felspar, a little compact, and of a greenish tint*.

1539. F. "*Grey porphyry* with a cement of petrosilex, of a greenish grey, enclosing a number of crystals of unctuous felspar of the same colour, though a little whiter, some pyrites, and some black ferruginous spots.

1539. G. "*Schistose porphyry* with a blackish cement the colour of iron, with a scaly and brilliant fracture, hard, containing crystals of dry white felspar, opake, which bubbles and readily melts under the blow-pipe, and other crystals of hornblende, pretty hard, of a blackish green."

Add porphyry with black chalcedony, from Chemnitz, in Saxony. (Linn. à Gmelin, 206.)

Aspect 4. Blue. Dark indigo blue porphyry, with crystals of yellowish felspar, from the isle of Rasay, Scotland.

See Mr. Jameson's Mineralogy of the Scotish Isles, ii. 117. He says the base is betwixt clay and hornstone, so it is only placed here to excite further enquiry concerning so beautiful and uncommon a rock.

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* Verd d'œillet. The French of Swiss and German authors is often peculiar.

STRUCTURE II. WITH SMALLER CRYSTALS.

Aspect 1. *Red*. Of Egypt, the fels frequently in white or in flesh-coloured

The same, with white only, the porph Pliny. It is sometimes interspersed with of a lighter or darker colour.

The same, from Corsica, from Lester Provence, Scotland, &c.

The same, with crystals of siderite.

Aspect 2. *Brown*. Of this Ferber two varieties; the liver brown with ht g spots, and the dark brown with spots and half green; perhaps he means cr black siderite and green felspar.

Dark brown porphyry, speckled with nume small crystals of felspar, and others of sid and quartz, with reddish and green Sweden, where it is manufactured high polish.

Aspect 3. *Black*. Entirely resemblir except in colour. Of this there are columns in a church near the gate of St. I Rome.

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* Wad, 12.

Aspect 4. Green. Resembling the red.

The same, with crystals of siderite.

From Ferber's description it would seem that the felspar is wanting, in which case it is a trap or basaltin.

The same, with small crystals of felspar in white spots, commonly irregular, and twisted like worms; the *Porfido verde fiorito*[*].

The red also occurs in Egyptian monuments, as well as the black[†]. Green porphyry is also found in Corsica and Norway.

MODE VI. PORPHYRIN.

This name has been adopted for porphyritic substances, in which the crystals of felspar are so small as almost to escape the eye, or not be discoverable without a lens. But somewhat of the regularity of true porphyry must be observable, otherwise the substance must be considered merely as a mingled basaltin. On the other hand, the mixture of a few grains of quartz may be admitted in a porphyrin; but if the base assume the granitic form, it must regarded as a granitic porphyry.

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[*] One kind so called is not a porphyry, but a waved mixture of siderite and felspar, as if daubed with a brush. See Anomalous Rocks.

[†] Wad, 12, 13.

Swedish porphyry.

The Swedish porphyry, already ati approaches nearer to a porphyrin; s of which are common in most porphyri gions, forming the passage from basaltin phyry.

MODE VII. PORPHYRON.

When the crystals of felspar exceed an inc in length, and are distant from each other, c cumstances which occur in the large nature, the rock may be termed P r The utility of these divisions will understood, as the science bec more studied.

MODE VIII. PORPHYROID.

This denomination includes such as approach the porphyritic structure. strict derivation of the term porphyry, ready explained, the black and green could only be termed porphyroids; but severity would too much violate com n porphyroid, as admitted into the side-vision, must be restricted to such rocks as base of siderite, basalt, or basaltin, pre- an appearance of porphyry. Some of mitive grunsteins of Werner fall under tribution. When the base is siderous, square crystals are barytic or calcareous, s denomination may also be adopted*. xtures called granitic porphyroids, &c. e arranged under their proper domains.

MODE IX. AMYGDALITE.

re the distinctive characters of a sub-vary much, they are omitted, to avoid ssary prolixity, especially as they may d in the common books of mineralogy; ks should be studied in themselves, as in books, for the only use of any classi- is to assist the memory.

substance, the *mandelstein*, or almond-f the Germans, has a base of coarse trap lton, in general black or brown, inter- with nodules or kernels of chalcedony, alcareous spar, zeolite, and green mag- Agates.

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green siderite, with crystals of calcareous spar, (Sauss.) may belong to this division.

nesite, or magnesian earth mingled with ir The agates afford valuable materials for facturers; and the rock abounds in many tries, as at Oberstein on the Rhine, other places on the river Tay, in whence the English lapidaries have l latter agates Scotch pebbles†. In t Italy the same rock presents chalced i are sometimes enhydrous, or con water. In the Faroe isles the chalce monly assumes the stalactitic form; an a Landt observes‡, it has been f li itself on straw or moss, whence it c ly to have been deposited by water; eit by its own caloric (for if water c principle of heat it would bec i l, by subterraneous fires, as the fountain of Iceland deposits silicious concretions.

Formations.

Werner considers Amygdalite as ations; the Transitive, the base of wl wacken, an argillaceous rock, someti ing to basaltin, which it generally c and sometimes to iron-stone, a mixture

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* This may also be called a *bole*, a shorter word than *lithomarge*, and expressive of the same substance, as appears from the analyses.

† This name seems also a distinction from the English pebbles in pudding-stone, &c. some of which are as beautiful as agates.

‡ P. 146.

and clay, which is also the chief repository of prehnite. The other formation belongs to his Floetz, horizontal, or stratiform rocks; and he also describes the base of this as being wacken, or rather decomposed grunstein, which, according to his theory, generally lies under basaltin and above clay. But Mr. Jameson, to whom we are greatly indebted for an exposition of the Wernerian system, omits amygdalite in his description of wacken; and Brochant regards the base of amygdalite as a decomposed siderite or grunstein, and it certainly belongs to this domain. It is believed that olivine, though frequent in basaltin, has never been observed in amygdalite, in which the silicious parts assume a different form.

Origin.

Some French mineralogists have supposed amygdalite to be of volcanic origin; but Patrin, though an ardent volcanist, has rejected this idea, and arranges it after porphyry, as he observes that the base is sometimes siderite, sometimes trap. The cavities are also larger than any found in lava; and though agates be so named from the river Achates in Sicily (in the south of that country, and at a great distance from Etna), it appears not that agates have ever been observed in any volcanic region.

Amygdalite, like basalt, often contains nodules of common steatite, and small crystals siderite. As it only takes a very coarse the base is properly a basalton.

STRUCTURE I. AMYGDALITE WITH AGATES.

From Oberstein on the Rhine.

The same, with cubic zeolite.

The same, with veins of glassy chalcedony, companied with a band of the colouri which would form agate.

Brown amygdalite, from the same.

Amygdalite, with chalcedony, zeolite, &c. the Isle of Skey.

Faujas has given a good list of the products of Kinnoul. Kinnoul, but ridiculously calls them lavas. He mentions black basaltin joined to basalton, the latter presenting small crystals of felspar, so as to assume a porphyritic appearance. The same compact basaltin, in columns. Green basalt, very firm and sonorous. Basalt with crys spar, and attracting the magnet. A s p of the same, with a carnelian on one of t The same, with globules of green earth, calcareous spar, &c.

Moca. Beautiful agates, or what are called stones, also occur in a rivulet called May, falls into the Ern near the house of C in

Perthshire. Moca-stones are also said to be found on the banks of the Tweed, being chalcedony mingled with green earth, bitumen, &c. in the form of moss, and other appearances. They receive their name from Moca, in Arabia; that is, like many other substances, not from their native site, but from the mart where they were sold, being brought to Moca from Cambaya in Hindostan, which also transmits beautiful carnelians and chalcedonies*. There are probably rocks of amygdalite in that vicinity. It would appear however that this rock is among the rarest products of nature, having seemingly been observed only in the four countries above mentioned; Hindostan, Sicily, Scotland, and the neighbourhood of Oberstein.

STRUCTURE II. AMYGDALITE WITH CALCAREOUS SPAR.

Toad-stone.

Of this the toad-stone of Derbyshire affords a well-known example. Patrin mentions another

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* It is said that the fine carnelian is produced by art from nodules of a kind of chalcedonic flint, which are left in the heat of orse-dung for many months. One of these flints I received from y highly-respected friend Mr. Ferguson, whose noble collection of inerals is known to all Europe. But, in the oriental phrase, his ve of science, and generous spirit, surpass all the gems in his abinet.

from Strelka, in Siberia, with crystals
and globules of steatite, in a base of liver-co
Variolite of Drac. trap. The variolite of the Drac, a t
throws itself into the Isere be G
belongs to this division. The
Patrin, is of trap, mingled with clay, or
German mineralogists would call a w
of a grey or violet colour, with spa
and globules of calcareous spar;
with globules of green steatite. In li
toad-stone of Derbyshire is oc
rarely, of a light brown colour, th
Saussure regards the variolites as
but Werner only classes them as ei
or stratiform.

Black amygdalite, or toad-stone, from
shire.

The same, with veins or nodules of red jasper.

Dark brown toad-stone, from the same.

Light brown, or fawn-coloured toad-stone,
green globules, from the same.

Variolite of the Drac, the Hartz, &c.

The calcareous spar sometim
and leaves a false appearance of

STRUCTURE III. AMYGDALITE WITH OPEN PORES.

This substance abounds in the high upland of Mexico, where it is of a reddish colour, and is the *etzontli* used in building. As that region abounds with volcanoes, it is probably a lava.

MODE X. IRON-STONE.

Characters

Texture, compact, granular or earthy, sometimes undulated. On the surface of English hills composed of this substance, it often presents a singular ornamented appearance, as if derived from pinnæ, or some other long pyramidal shell, with transverse bars; and is sometimes covered with yellow rust from the decomposition of the iron.

Hardness, basaltic. Fragments, amorphous, ather sharp.

Weight, siderose.

Lustre, dull, opake.

Sites.

This substance forms many small chains of ills in England, as in Surry, &c. and in other ountries, yet has scarcely been identified in ooks of mineralogy. Ferber, in his oryctoraphy of Derbyshire, mentions iron-stone as

composed of a bluish heavy clay, with an appearance of containing much iron; he also mentions a brown kind, found in the coal-mines of Stansby. This rock contains from 20 to 40 of iron, and when rich in that metal is worked as an ore; being a *Gemeiner Thoneisenstein* of Werner, which contains about 40 parts of iron in the 100. But none are here intended to be i ed
which exceed 20 or 25. It is supposed
rally to indicate coal; and if so, that
may be expected in Surry. The clay
argillaceous iron-ore, has commonly or
red appearance; while this is grey
and probably contains no more iron t
The name iron-stone is commonly used r
and other counties; but it probably
the vague *whins* of the North. It is
gangart of prehnite*.

STRUCTURE I. OMPACT.

Iron-stone, from Surry, Shropshire, &c.

The same, with prehnite, from Dunbarton, &c.

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* Mountains of iron-stone exist in the East, if we credit Arab. Nights, vi. 239, of Dr. Scott's edit. 1811.

STRUCTURE II. COLUMNAR.

Mr. Sowerby possesses in his valuable museum a curious example of this kind, being quadrangular columns of iron-stone passing through slate.

STRUCTURE III. VARIEGATED.

This kind, with an appearance of shells, &c. has been already mentioned.

Rock of the Capitol.

The rock upon which the Capitol of Rome was founded, is thus described by Breislak. 1. The colour is brick red, but with spots of a deeper tinge, and which are also of a larger grain. 2. Its hardness surpasses that of tufa, but is inferior to that of lava, being comparable with that of the freestone used at Paris. 3. If large pieces be broken off with the hammer, the fracture is even conchoidal; in small the fracture is unequal, small grained, but never rough. 4. It acts on the magnetic needle at the distance of two or three lines. 5. It contains scales of mica, fragments of felspar, and white globules of calcareous spar, with some fragments of melanite. 6. Observed in the sun with a good lens, the whole mass is found to be crystallised.

If this rock be not a red basalt, it may pass into the Mode of Iron-stone, as appears fr action on the magnet.

The stone which serves as a gangart to quartz crystals called Bristol diamond, be ranked in this division; but it se a vein-stone passing through kinds of iron-stone, siliceous and arg often occur in mines, but have not been constitute rocks.

The following substance may also this division.

Iron clay of Werner.

"Iron clay.

"Eisenthorn.—Werner.

"*External Characters.*

"Its colour is commonly br seldom approaches to blood r , t to reddish brown.

"Occurs almost always v with empty, sometimes with filled

"Internally it is dull.

"Fracture fine, earthy, conchoidal.

"Fragments indeterminately

"Is soft, but sometimes into

"Is not particularly di ltly f

"Not particularly heavy, in a mid

"*Geognostic Situation.*

elongs to the floetz-trap rocks, and con- like wacken, the basis of amygdaloid.

"*Observations.*

distinguished from wacken by its colour, greater proportion of iron which enters omposition.

he iron which it contains is very much whereas that in basalt is slightly oxyd-

MODE XI. JASPER.

re, very fine grained and compact, some- ther earthy. Characters.

ess, crystallic, sometimes only felsparic. conchoidal. Fragments, angular sharp. t, sometimes siderose, sometimes grani-

, glistening, rising to shining, but some- ll. Opake; sometimes translucent on s, but it then passes to jaspagate.

ost frequent colour of jasper is the red, s been found to contain from 16 to 20

---

he additions to Mr. Jameson's Mineralogy, ii. 603.

of iron, and often attracts the magnet. It surprising that analyses have not been made of a substance regarded as valuable.

Basanite. Basanite, or the Lydian stone, is by ı regarded as a black jasper, seemingly with r son, for its geognostic relations in veins, resemble those of the other jaspers, and veins of quartz often traverse both kinds.

White jasper. The existence of white jasper has rece been granted; but even this colour does not refuse the presence of abundant iron, as may be observed in the white ore of iron called steel ore, or the spary iron ore, which is found to c from 30 to 40 of iron, with more than manganese.

The black being admitted, jasper may to present all colours, except blue, which however to occur in New Spain, or at l a green approaching nearly to blue. The sin

Sinople. or red jasper of Hungary, sometimes c i gold*; and is said by Born to hold 18 ir When Mr. Kirwan argues against this, the comparative lightness, he forgets tl y ochres, and even ores of iron, are com light; nor is that metal itself of gr

---

* The sinople of Heralds is green! The earth of Sinop Pliny) was red.

ty, being much inferior even to tin or
er.

Sites.

Mountains of striped jasper occur in Siberia,
often with breccias, but without petrifac-
, per Herman. 1 Berg. Jour. 1791, p. 84
94; of red jasper, ibid. 88; and also of
jasper, 2 Gmelin. 81. (French.) It often
thick strata in mountains of schistose mica
e Apennines, Ferber, Italy, 109; and in
ia, 2 Herm. 281. In Saxony it is found
iating with, and sometimes mixed with,
act red iron-stone, 2 Berg. Jour. 1788.

n the south of France it occurs, reposing
ranite, and underlaying basalt, 3 Soulavie.
In the Altaischan Mountains it has never
found in contact with granite, but it some-
s underlays argillite. 6 Nev. Nord. Beytr.
"[*]

Salisbury Crags, near Edinburgh, a curious
r, spotted with metallic iron, occurs under
basalt. Saussure and Dolomieu have ob-
d that jasper is chiefly of an argillaceous
re, more or less penetrated with oxyd of
Patrin has given an interesting account
mountains of jasper in Siberia[†], where he

Of Siberia

---

[*] Kirwan, G. E. 177.

[†] ii. 266.

conceives that what he calls petrosilex
into jasper, by the influence of the atr
but in this he judges from the col
from the analysis. His primitive
he declares, is felsite, while he
which he calls primitive, after his sec
trosilex, which he expressly menti
hornstein of Werner. There is tl
confusion in his context, as he deriv
rock from a secondary substance;
trosilex must be itself regarded
imperfect jasper; nor is it inco
the surface may even attract more
atmosphere, where atoms of that s
stantly float, as has ap t
ments and inferences. Tl
pers of Siberia appear on the
southern part of the Uralian cl
the ribbon jasper, green and red, d
ted with pitchstone, or perl s
Another beautiful kind prese
base, little undulating veins of olive
companied by a white thread which
the undulations. In Daouria, on t
of the river Argun, one of the sourc
Amur, there is a famous mountain c
green jasper; but, like the other ki it
not rise in large pieces, but splits into l

nts. He observes that jasper is generally
istose. A late traveller has informed us that
untains of jasper extend for perhaps more
an a thousand miles through the eastern part
Siberia, including Gore Island, between that
untry and North America. On the contrary
e grand chains of European mountains seldom
never present this substance; which is chiefly
und in Sicily, Bohemia, and Saxony.

It must be observed that many of the jaspers
ther belong to lithology or gemmology, being
ly found in geods or small veins. Nor is it
tended to be affirmed that they all belong to
e siderous domain, though the black, the red,
d the green, which are found in the greatest
undance, appear always to belong to that di-
ision; and it may be observed that these co-
urs also occur in basaltin, like which also jas-
er occurs in columns at Dunbar, in Scotland.

STRUCTURE I. COMMON.

Aspect 1. *Black jasper.* It is doubtful whether
is substance, the basanite or Lydian stone of
erner, form entire mountains, though Kirwan
ems rather to imply that it does: but the sili-
ous schistus of Werner, which includes basanite,
so vague an appellation as to convey no idea;

and the application of the term has embarr even the most skilful mineralogists.

Black jasper, from Prague.

The same, from Leipsic.

The same, from Hainchen, near Freyberg, Saxony.

The same, from the Pentland hills, near E burgh[*].

Aspect 2. *Red jasper*, from Saxony.

The same, with granite adhering to b from the Spizleite, near Schneeberg.

Red jasper, or sinople, with grains of from Hungary.

The same, from Siberia, where it ri tains[†].

Aspect 3. *Green jasper*, from Daou it composes a mountain.

Aspect 4. *Striped jasper*. In green and stripes, from Siberia, where it forms a chain mountains.

---

[*] Brongniart, I. 327, regards the siliceous schistus of a *schistose jasper*. He might rather, with Faujas, have black jasper, most jaspers being schistose. As iron f dominant principle of jasper, and black is the most usual its compounds, it would be absurd to reject black jasper.

[†] German and Dutch travellers sometimes call red jasper cor

Brown jasper, it is believed, may also form mountains or rocks; but the other kinds, as the Egyptian, the jaspagate, &c. are only found in small pieces, commonly globular.

STRUCTURE II. COLUMNAR.

This structure is very rare, and scarcely occurs except at Dunbar, in the south of Scotland, where the interstices of the pillars are filled with siliceous cement.

MODE XII. SLATE.

Characters.

Texture, eminently schistose or slaty, commonly straight, sometimes curved or undulating, of a very fine or impalpable grain.

Hardness, from marmoric to basaltic. Fragments, sharp, splintery, sometimes rhomboidal.

Weight, granitose.

Lustre, sometimes dull, sometimes silky. Opake.

The colour is most generally bluish, but sometimes greenish, or a purple red; also yellowish, and sometimes with stripes or spots of a darker colour. It is the *thonschiefer*, or clay-slate, of Werner, the argillaceous schistus of many English

Names.

and French mineralogists, being by all
a primitive rock. As it has been found to
tain from 14 to 20 of iron, it strictly bel
this domain, the clay being a very infe
sideration. It has also a metallic ap
and sound, very different from schistose c
clay-slate, strictly to be so denomir . T
simple term SLATE, besides the adv
being in general use, has been thought
to discriminate it by way of emi . It
nerally contains a portion of mag
when this is abundant, as appears to
cated in those kinds which have a very si
satiny appearance, it may be ranked
the magnesian rocks. It often presents py
either in a cubic or dundritic f
schorl, and even garnet and siderite.
also appears; and a recent discovery c
or hollow spar. Scales of mic
in many other substances; it
passes into mica-slate: and Daubu
monstrated, by an operose chem al
that they may be regarded as different
the same ingredients.

It often forms entire mountains, l
monly only a part, alternating with
mica-slate: nay, according to Ki l
las, both granite and gneiss often r

es veins of granite are found to pass this substance, which must not be acs only appearing in the finer form used s, but also in coarse and thick schisti, etimes, though rarely, even massive.

oubtful whether the yellow argillaceous which composes the famous mountain i, belongs to this description; as the ous schistus, or the clay-slate of many untries, so remarkably metalliferous, be classed under this division; which vinces the utility, if not necessity, of a r abundance of definitive denominations w science. But Helms seems to con Andes as chiefly composed of what calls *primeval blue argillite;* and he dehe yellow slate of Potosi as being exhard. If they contain from 10 to 20 of y belong to this division; and as iron y accompanies the richest ores, it is that its presence is here indicated. nboldt regards that amazing chain of s as chiefly composed of what is called ous porphyry; while those of New Spain rgillaceous schistus: roofing-slate, and atives, being regarded as rare.

Potosi.

are valuable quarries of slate in Cornles, Westmoreland, and Scotland. A

Quarries.

curious account of the manner of working t of France, near Angers, may be found in *Journal des Mines*.

In his account of the primitive schisti, Patr has the following article*:

Slate of Ural.

“*Ferruginous schistus.* This slate is composed of hardened clay, abundantly with an oxyd of iron, either black or sometimes red or yellow; a little quartz; much mica. This rock is one of the c mon in the northern countries, where n singularly abundant. The eastern of t Uralian chain of mountains, f es about 500 leagues from north to south, is a entirely composed of this rock.”

The same able author gives the following count of the slate-mines at Charleville Meuse, which he regards as primitive; afterwards of those of Angers, considered him as secondary.

“The slate-mines of Charleville are plored by open quarries, like those slate, but by subterranean galleries, roof of the bed of slate is composed of of quartzose schistus, very hard and very and besides, the slate plunges very rapidly this rock, which would render enormous clearages necessary, and would expose the workmen to great danger from falls of the rock.

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* i. 120.

"The principal slate-mine of this country is that of Rimogne, four leagues to the west of Charleville. It is in a hill, of which the centre is primitive, but the skirts are in part covered with beds containing shells. The mouth of the mine is towards the summit; the bed explored inclines forty degrees to the horizon, so that to advance four feet, you must descend about three feet perpendicular. The workmen call this bed the plate, on account of its form, which is flat and thin, if the extent be considered. Its thickness is nevertheless sixty feet; but its length and breadth are incomparably greater, and their limits remain unknown. It has been pursued, by a principal gallery, to the depth of 400 feet; and they have driven many lateral galleries, which are prolonged about two hundred feet, on each side of the main gallery; where are placed, in succession, twenty-six ladders, for the passage of the workmen, and the carriage of the slate.

"But in this thickness of 60 feet, there are only 40 of good slate: the remaining 20 of the underpart are full of quartz, and unmanageable. The rock, which forms the immediate roof of the

slate bed, is a granular quartzose schistus,
grit by the workmen; while the other
beds are of a friable clay-slate, of an iron

"This bed of slate is the most c
known in the country, and I doubt if any
be found elsewhere. The slate resem
of Angers, in its quality, and its deep
lour.

"That of the other quarries in t
of Charleville is subject to be mingl
rites, and intersected in all directions
of quartz, which are called *cord* . T
of some mines are greenish, like
quarries in the Pyrenees.

"In order to quarry these s
blocks about 200 pounds in weig
called *faix*. Every workman in h
them on his back to the very m
mounting with infinite labour
ladders of the great gallery, or at
cording to the depth of the bed. W
to the working place, these bloc
into thick tables, which are
this operation is easy: the workman
block between his legs, puts a ch l
to the side, and divides it with t
mallet. The *repartons* are treated in
way; he only takes care when they

thin, to break them in two, by their breadth, in order to prevent their fracture. These operations must be performed soon after the blocks are drawn from the quarry; for if the stone has time to dry, it would no longer be possible to split it.

"The engineer Vialet, who has given a memoir on this slate-mine, says he found a mean of giving these slates double their natural hardness, which was by baking them in a brick-kiln, till they had assumed a red colour. In this case they are not more brittle than before; but as they acquire great hardness by this process, as indeed any argillaceous substances will do, they ought to be formed and pierced before they are put into the oven.

"It is surprising that the slate of Rimogne presents no vestige of marine bodies, while the neighbouring lands are full of them; but this surprise will cease, when it is observed that nature has formed the different portions at epochs, and under circumstances, widely different."*

Nor is his account of the slate quarries of Angers less interesting, which he places among the secondary, and regards as far more rare than the primitive.

"France possesses many of these large beds

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* Patrin Min. iii. 297.

of slate, chiefly near Laferriere in Norma
and in the neighbourhood of Angers. The
is the most important; it furnishes slate of
most perfect quality; and its extent and p
digious thickness make it be regarded as
exhaustible.

"This bed extends for a space of two
from Avrillè to Trèlazè, passing under
where the Mayenne, which comes
north, cuts it at right angles.

"The town of Angers is not only covered
built with slate, those blocks being employ
masonry which are the least divisible.

"The quarries which are actually ex
are all in the same line, from west to
well as the ancient pits; it being in
rection that, by the exterior disposition
soil, the bed of slate presents itself n
surface. Immediately under the v
is found a brittle kind of slate,
or five feet in depth, splits into litt
of some inches, which have the form of
boid, or a portion of that figure.

"A little lower is found what they c
ing stone, being a pretty firm slate, but
divisible into leaves. This is employed
construction of houses, after it has been
ciently hardened by being dried in the open

urteen or fifteen feet from the surface
he good slate, which has been quarried
rpendicular depth of about 300 feet,
ning thickness being unknown.
perations are conducted by open quar-
successive *foncées*, trenches, of about
deep, gradually narrowed, in order to
a slope sufficient to prevent lapses of
so that a trench, four hundred feet in
the opening of the quarry, shall be re-
nothing at the thirtieth *foncée*, that is
of 270 feet. There is every reason to
that a far greater depth might be at-
d with more advantage, as the lower
gone the more perfect is the slate.
e only been stopped by the difficulties
by the method of quarrying hitherto
which appears not to have been the
ne respect particularly, which is, that
tity of slate diminishes as the quality
better, so that in the total mass those
dling quality are far more numerous.
seem that the method of subterranean
would prevent the inconveniencies of
nt plan; there would not at least be
overwhelmed a prodigious quantity of
slate. The slate-mines of Charleville
ve as an example; where, in spite of

the disadvantageous situation of the bed, wh renders it more difficult to be worked than i were horizontal, the product amply repays t undertakers, though the galleries be of g length, and some even pass under the ri Meuse. Slate is far more valuable than co and yet all mines of the latter are explored pits and galleries, sometimes of immense dept those of Charleroi, in the Netherlands, are ab two thousand four hundred feet in perpendicu depth; those of Whitehaven, in England, ab five thousand, while they extend more than h a league under the sea. But works conduct with skill overcome the difficulties which a produced by these subterraneous excavatio which are repaid with great profit, and no p of the mineral treasure is lost. It would the fore be of great consequence to try if the meth of galleries could not be adopted at Angers.

"As to the interior structure of this gr mass of slate, it is divided by many veins of c careous spar and quartz, about two feet thi by fifteen or sixteen in height; they are paral amongst themselves, and proceed regularly fr west to east, in a situation which approach the vertical, as they only decline seventy d grees towards the south. These veins are at intervals by similar veins, whose direction

; and of which the inclination is also
degrees, but in an opposite sense, so that
ey meet the former they either form
or half rhombs, which Guettard com-
the letter V; some being upright, while
e reversed.

he layers or leaves of the slate have a
and inclination similar to those of the
s of quartz; that is to say, that they
ity degrees towards the south, and dip
the north: and even when intersected
which have an opposite inclination,
not changed. The whole mass is thus
nto immense rhomboids, composed of
parallel amongst themselves, and with
pposite faces of the rhomboid.

slate of Angers is extracted in blocks
d size, which are divided, as at Charle-
o *repartons* and leaves. It is betwixt
ves that there are frequently found ves-
marine animals, and above all pyritous
ns of *pous-de-mer* (the sea-louse, a little
shell of the courie kind); of little *che-*
hrimps or prawns); and a kind of crab,
the body is about a foot in breadth,
een or fifteen inches in length, the tail
ine or ten rings. The shrimps are
s so numerous, that Guettard counted

phenomena as that of Angers. It is a substan
as rare in other countries as in France, the
being only one or two quarries in England, i
the county of Caernarvon. Switzerland posses
no slate, except in the valley of Sernst, in t
canton of Glaris.

"Italy has only one slate-quarry, that of La
vagna, in the state of Genoa, which furnishes
slate of an excellent quality, and so impen
trable to fluids, that it serves to line the cistern
in which olive-oil is preserved.

"Germany presents many kinds of secondar
slate (clay-slate), containing impressions of rep
tiles, fish, and other animals; but these impres
sions have a considerable relievo, and it is ev
dent that the animal has existed. The mo
remarkable of these slate-quarries are those
Eisleben, in Saxony; of Ilmenau; of Mansf
in Thuringia; and of Pappenheim, in Franco
I have often seen, in the mountains of Siber
beds of primitive slate, more or less considerab
but they are mostly aluminous, and furnish
kamennoie maslo, or rock butter, a fat yellow
substance of a penetrating smell, being a m
ture of alum and fluid bitumen. But I [illegible]
knowledge that in all this immense country th
is one bed of secondary slate. Nor does Bo

his Natural History of Spain, indicate that e has observed any in that kingdom*."

To these accounts may be subjoined a short lescription of a remarkable quarry in Cornwall, nknown to Patrin.

"Between Liskeard and the Tamar, on the outh-west, are some quarries of slate, which upply the inhabitants of Plymouth with covering for their houses, and for the purpose of exportation. Several quarries have also been opened at other places; but the best covering-slate in Cornwall, or perhaps in England, is procured at Denyball, nearly two miles south of Tintagel, in the north part of the county. The whole quarry is about 300 yards long, 100 broad, and almost 40 fathoms in depth. The slate-rock is disposed in strata, dipping to the south-west, and preserving that inclination from top to bottom. It is first met with at about three feet below the surface of the ground, in a loose, shattery state, with short and frequent fissures; the laminæ of unequal thickness, but not horizontal. Thus it continues to the depth of ten or twelve fathoms, when a more firm and useful stone is procured, the largest pieces of which are used for flat pavements. This is called the top-stone, and continues for ten after which the quality improves with creasing depth, till, at the twenty-fourth from the surface, the workmen arrive most superior kind, called the bott The colour is grey blue; and the text close, that it will sound like a piece o The masses are separated from the r wedges, driven by sledges of iron, and from five to fourteen superficial square stone.

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* Patrin Min. iii. 307.

"As soon as this mass is freed by another stone-cutter, with a strong and mallet, is ready to cleave it to thinness, which is usually about one an inch: the pieces are generally fr square to two feet long, by one w flakes are sometimes large enough and tomb-stones*."

STRUCTURE I. COMMON.

Aspect 1. Ash grey slate, from A France.

Bluish grey slate, from Westmorland.

Purple or reddish purple slate, from A

The same, with pyrites, &c.

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[*] Brayley's Beauties of England, ii. 329.

Aspect 2. Killas, from Cornwall, many varieties; blue, grey, or whitish yellow. If it contain only 6 of iron, it belongs to the argillaceous or to the magnesian schisti.

STRUCTURE II. MASSIVE.

The same identic substance of which slate is composed has been discovered in France, and other countries, in a massive form, or stratified with the seams at great distances, and incapable of being split into thin plates, like common slate. It may probably be often discovered in the vicinity of slate-quarries.

The slate with impressions so frequently found with coal, and called shale, is commonly of an earthy texture, and belongs to clay-slate.

Saussure mentions slate in columns like basalt*. He also enumerates the following:

§ 598. Granite, joined with slate; the last being composed of mica and *pierre de corne*.

§ 1862. A slate, with mica, in leaves thinner than paper, sometimes straight, sometimes undulated. It is, according to Saussure, a mixture of ferruginous clay and mica.

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* i. p. 523, 4to.

§ 2122. On the passage of Simplon
mediate slate, between the mica and the c
of a brilliant and undulated appearance,
ing garnets.

MODE XIII. MICA SLATE.

Arrangement. It is difficult properly to
Though it contain a great quantity q
has always been classed among
substances, as the mica is the ch
istic. Mica sometimes contains
but according to the analyses
the brown, grey, or black, which are
abundant and common in mica sla c
greater portion of iron than of gil,
tity of potash being also conside
found 9 parts of iron in mica;
20: even of the colourless kind
covered 15 in one sort, and 22 in

Connexions. Mica slate has also a natural c
common slate, into which it of It
must also be observed that Saussure

---

* Daubuisson's curious and elaborate analysis (Jour. de Ph. 1809) proves, that the composition of mica slate and slate is identically the same. The *mode* forms the only difference.

lps rocks in which scales of iron supplied the lace of mica. In all events the black mica ust belong to the siderous division; while the hite mica, which might be called micarel, and ometimes passes into steatite, ought to be classed mong the magnesian substances*.

Mica slate has a further affinity with the siderous substances, as, like siderite, it frequently ontains garnets. It is very metalliferous, many f the mines of Norway and Sweden, and a part of those of Saxony and Hungary, being situated in this rock.

STRUCTURE I. REGULAR.

Mica slate of a jet black, with black quartz, from Switzerland.

Grey mica slate from Scotland, where it abounds in the Grampian Mountains and some of the isles; not to mention innumerable other regions.

Grey mica slate, used for ovens (Stellstein), from Sweden. Wall. i. 427.

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* Kirwan has called the brownish black mica *micarelle*, because it contains *no magnesia* ! Klaproth found in it:

0063	argil
295	silex
675	iron
1033	

In very thin plates, and of an almost pable grain, from Scotland.

Brown mica slate, from the same c

The green and white need not

STRUCTURE II. IRREGULAR.

The noted *hornberg* of the Swedes this division, being a coarse mica slate ir contorted. It is very metalliferous*. celebrated rock with a barbarous may be called Linnite, in honour of J native of Sweden, who however cont little to its mineralogy.

Linnite, from Sweden.

The same, from Norway.

STRUCTURE III. MINGLED.

When mica slate is mingled w constitutes the Murkstein, or Norka, and the latter name might be retained, but garnets form so common an ad ; of slate, that the distinction seems un e

Mica slate, with garnets, from countries.

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[*] See *Journal des Mines*, No. 88, p. 257. It is g ish, with thick and short layers.

'he same, with schorl, from the Grampians.

'he same, with sappare, the kyanite of Wer-, from the mainland of Shetland, and from erdeenshire*.

The same, with various ores.

;aussure mentions the following varieties:

\ rock of reddish mica slate, of which the 'es, being often curved, present at intervals ırtz in the form of lentiles, but often some hes in length, and one or two in thickness. 366.

\ remarkable mica slate, composed of thin ite and grey leaves, so as to appear on the es like a striped stuff; the grey part being :a, and the white a very fine arenaceous quartz. 474.

A gneiss, composed of jad and siderite; his jad ing probably compact felspar. § 1331.

A part of the chain of Mont Blanc consists of a 'd ferruginous quartz, mixed with mica. § 847.

Sappare is the ancient Scottish name, retained by Saussure, who ırms us that he first received the substance from the duke of rdon. Werner's alteration is alike useless and absurd, the ori-al appellation implying its similarity to sapphire, for which it sometimes been substituted by jewellers.

MODE XIV. SIDEROMAGNESI

These rocks are far from being among primitive mountains, ch posed of magnesia and oxy ot substance called chlorite by er r, green colour, the iron often exceeds in the hundred; and it is even d that metal. Of actinote*, by so nolite, some kinds contain as m found in siderite; and it is in as only a different structure of th sure indeed regarded chlorite as earthy siderite; but as it contai portion of magnesia than siderite, in substance is scarcely recognisable, it proper to allot to these rocks an and the chemical *mode of comb* very different.

Chlorite and actinote.

To this Mode may also be mixture of iron and magnesia, tho which contain so great a portion affect the magnet. Most of the consist of iron and clay. The ei k

Some serpentines.

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* From the Greek ακτινοτος, *radiated*, so that the y the orthography.

n-flint, of Werner, is merely a vein-stone, ver appears in the shape of a rock; and lly the silex in siderous substances is lost argil. The *sidero-calcite* and *ferri-calcite* wan have little connexion with the present t, the former being pearl-spar, the latter mbracing a few lime-stones, which contain 0 to 20 of iron; but as they easily decom- present no remarkable variety, and are nteresting, it is unnecessary to distinguish except as mere diversities of lime-stone. erable marbles are tinged with iron, from they chiefly derive their colours; but it be a too nice and useless distinction to se an arrangement from this mere acci- which varies in different parts of the rock. There remain therefore only the esian rocks to be specially considered in onjunction with iron, a metal with which ave often a singular affinity.

STRUCTURE I. CHLORITE.

s substance is by Werner divided into four chlorite earth, common or compact chlo- liated chlorite, and chlorite slate. It seems wn to Wallerius, who published his last in 1772; but is the green talc of Born, and the Samnterd of old German writers, from its velvety appearance. To the C miners, as it often occurs with tin, it is by the name of *peach**.

The first Aspect, that of chlorite scarcely be said to form a rock, chiefly in clay-slate, and probably forming the gre dules in basaltin. The second kind unknown, save as a vein-stone; and w the foliated is generally crystallised, at St. Gothard with other crystals. rock therefore of the kind is:

Aspect 1. Chlorite slate. Texture, nulated, sometimes regularly, some larly; schistose, so that fragments s sume the form of a wedge.

Hardness, gypsic. Fracture, sometimes or undulating, or scaly. Fragments, slaty, except when mixed with quartz.

Weight, sometimes granitose, sometim bonose.

Lustre, glistening, somewhat resinous. C

Chlorite slate, from Egypt. Wad, 23, statue.

Chlorite slate, from Corsica, Norway,

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* It is the *taldogea* of Saussure, so called from

iria, Tyrol, Scotland, &c. It is generally sprin- ed with octaedral crystals of iron, and some- nes with garnets. The first are the most cha- cteristic of this rock.

Chlorite slate, mixed with quartz. This kind commonly even schistose, but far more hard an the former.

Saussure, § 2264, expresses great surprise, hen, on receiving specimens of the chlorite slate f Werner, he observed that there was scarcely ny chlorite in them; and he adds, that the denomination being quite deceitful, it ought to be changed.

On the lofty summit called the Col du Géant, Saussure found that the granite, like that which is greatly elevated at Mont Blanc, can scarcely be said to contain mica. Here its place was often supplied by a small-grained chlorite*.

STRUCTURE II. ACTINOTE.

This substance also chiefly occurs in small portions. It is the strahlstein of the Germans, and is by Werner divided into the asbestoid, the common, and the glassy. Of these it is believed the

Glassy actinote.

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* Sauss. § 204.

last only appears in the form of rocks.
who calls it delphinite, or green schorl
phiny, describes a rock of this kind.
mentions smaller portions of a c

That the glassy actinote strictly
siderous domain, will appear by the
Vauquelin; silex 37, argil 21, lime 15,
iron 24, with a small portion of man

Texture, sometimes massive, but
thin six-sided acicular crystals.

Hardness, between marmoric
Fracture, fibrous and radiated. F
tery and very sharp.

Weight, siderose.

Lustre, shining and glassy; stro
cent.

Actinote, from Switzerland, where, as has been mentioned, it forms entire rocks.

STRUCTURE III. SIDEROUS SERPENTINE.

Of this kind Humboldt discovered a curious rock with magnetic power, forming the mountain of Regelberg, in Germany; the south side attract-

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* Lametherie observes, that the earthy smell shows an approximation to hornblende. Th. de la Terre, ii. 373. Is not schorl a black actinote?

ng the north pole, and the northern side the south ole.

Rocks of the same kind may probably be discovered in other countries; at any rate many serpentines are so replete with iron as to fall into this division.

Saussure, § 1342, gives a minute description of what he calls granular serpentine. It is so much impregnated with iron, that it belongs to the sideromagnesian rocks.

The mountain called Roth Horn is in a great part composed of compact serpentine, semi-hard, that is, of the hardness of marble. It is called the Red Horn, because the serpentine, though green within, is red on the surface, from the oxydtion of the iron*.

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* Sauss. § 2157.

MODE XV. SIDEROUS INTRITE.

Intrites.

The rocks here called INTRITES, be tals or particles are imbedded in a distinguished from Glutenites, in whi ticles coalesce together with little or cement. The former have by the been styled porphyries, from a si structure; but the interspersion of c tals, especially of felspar or felsite, common as mica, can hardly even alter the nature of the rock; and stances ought in geology to be c their parent base; for while all t pretended porphyries are classed u by Werner and his disciples, gr c arises from their totally different natures.

In the present work the intrites and g are classed under the several domains to ich they belong; but as the bases are of kinds, it has been thought advisable to them under one point of view, at the each domain. As however the chief intrites are the genuine porphyries, the servation of that classical and universal name will considerably restrict the present division.

STRUCTURE I. VARIOLITES.

When the crystals, instead of being of an oblong cubic form, as in porphyries, assume an oval, but particularly a round shape, the rock may be aptly styled a variolite, every denomination being useful which saves circumlocution.

Variolites of Durance.

The stones called variolites of Durance, being pebbles rolled down by that river in Dauphiny, belong to this article[*]. The prominence of the round crystals of felspar, having a faint resemblance to the pustules of the small-pox, has occasioned this appellation. Patrin[†] has minutely described the variolites of Durance, as being in his eye the same with the ancient green porphyry, being a *cornéenne*, or basaltin, fusible into a black amel attractable by the magnet. The spots, of a finer green, or sometimes white, are often surrounded with two zones of these colours. Saussure, whose description is very minute, § 1539, regards the globules as composed of that kind of felspar which, being of a greasy appearance, like one of the kinds of quartz, is called unctuous felspar, or rather felsite; for Werner has pronounced that the felspar in the ancient porphyries is compact.

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[*] Faujas says that he found, near the village of Servières, the rocks which afford the variolites of Durance. For those of the Drac, see Amygdalite.

[†] i. 147.

The [illegible] i [illegible] t [illegible] 1 [illegible] e of a b[illegible] of a [illegible] u [illegible] s [illegible], of [illegible] ii [illegible] is [illegible] re[illegible] grey, of a bright b[illegible]k red.

Saussure mentions, § 1289, a ki[illegible] olite, seemingly composed of green [illegible] spots of white felspar, sometimes r[illegible] sometimes circular.

STRUCTURE II. IRON-STONE WITH CRYSTALS.

Iron-stone, with crystals of quartz, [illegible] Surry hills.

Saussure mentions, § 1322, a red porphyry, or rather intrite, mixed [illegible] and actinote; the base being of

MODE XVI. SIDEROUS GLUTENITE.

Glutenites, how classed.

In arranging these substances, two objects are to be considered; the nature of the fragments or particles cemented, and that of the cement itself. When they are both of one kind, as a siliceous bricia*, or a pudding-stone with a siliceous cement, there can arise no doubt concerning their classification: but when, as often happens, the fragments are of one kind, and the cement of another, the domain may appear doubtful. The more general method however appears to have been, to denominate the substances from the cement, as being the predominating agent; and this rule is particularly applicable in the present instance, as oxyd of iron forms the strongest of natural cements. Bricias of basaltin or jasper are commonly cemented by the same substance, and sometimes, though rarely, by quartz; but they may still be referred to the predominating substance, the

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[*] This word is strictly Italian; *bricia*, a crumb or small fragment, with its derivatives *bricioletta*, a little crumb, *briciolino*, and *briciolo*. Breccia is only a corruption.

The Italian architects and statuaries gave the first modern classical names to rocks, as *granito*, *granitone*, *granitino*, &c. &c.

quartz being common, and of inferior consideration.

Bricias and pudding-stones.

The division of glutenites into bricias and pudding-stones, the former consisting of angular fragments, the latter of round or oval pebbles, would not be unadvisable, were it in strict
formity with nature. But there are
of this kind; as, for example, the
Egyptian bricia, in which the fi
partly round and partly angular*; w
term glutenite is liable to no such
and the several structures identify t
substances.

English pudding-stone.

The celebrated English pudding
no where in the world but in Her
pears to me to be rather an original rock,
in the manner of amygdalites, because
bles do not seem to have been rolled by
which would have worn off the su in
various directions; while, on the c
white, black, brown, or red circlets, are
entire, and parallel with the surface, lil
of agates. Pebbles therefore, inst
united to form such rocks, may, in cir-
cumstances, proceed from their dec

---

* So also the celebrated pudding-stone of England.
malous Rocks.

ie circumjacent sand also arising from the deomposition of the cement.

Sites.

Mountains or regions of real glutenite often, however, accompany the skirts of extensive chains of mountains, as on the north-west and south-east sides of the Grampian mountains in Scotland, in which instance the cement is affirmed by many travellers to be ferruginous, or sometimes argillaceous. The largeness or minuteness of the pebbles or particles cannot be said to alter the nature of the substance; so that a fine sandstone is also a glutenite, if viewed by the microscope. They may be divided into two structures: the large-grained, comprising bricias and pudding-stones; and the small-grained, or sandstones.

STRUCTURE I. LARGE-GRAINED GLUTENITES.

Siderous glutenite, or pudding-stone, from Dunstafnage, in Scotland, where it forms romantic rocks of a singularly abrupt appearance, in some parts resembling walls. The kernels consist of white quartz, with green or black trap, porphyries, and basaltins.

Glutenite, from the south of the Grampians, from Ayrshire, from Inglestone bridge, on the road between Edinburgh and Lanark. But of these the cement is often siliceous, as in those at the foot of the Alps, observed by Saussure. The siderous glutenites commonly originate from the decomposition of siderous rocks, which also afforded the cement.

Glutenite, consisting of fragments of gra cemented by trap.

Siderous glutenite, or pudding-stone of the modern formation. This is formed around nons, pistols, and other instruments of iron, the sand of the sea.

Glutenite of small quartz pebbles, in a red ferruginous cement, found in the coal-mines near Bristol, &c.

Basaltic bricia, from Arthur's Seat, near Edinburgh.

Porphyritic bricia (*Linn. a Gmelin,* 247), from Dalecarlia in Sweden, and Saxony. Calton-hill, Edinburgh?

STRUCTURE II. SMALL-GRAINED.

Aspect 1. The most remarkable of the siderous sand-stones, is that celebrated by the German geologists under the appellation, given by the miners, of *Rothe todt liegendes*, or the *red and dead layer*, so called from its colour, and because it is wholly unproductive, no minerals being found

Rothe todt liegendes.

in or under it. This singular rock has been termed *semiprotolite* by Mr. Kirwan, implying that it is half primitive; and he informs us that it is commonly found under coal, is micaceous, and contains lumps of porphyry or granite. The grains are generally quartz or keralite, the cement being an irony clay, which imparts the colour.

But as the passage affords some curious German learning on the subject, from books little known in this country, it shall be presented entire.

" *Semiprotolites (Rothe todt liegendes)*.

"These stones I call by this name, as being partly of primeval, and partly of subsequent, origin: they consist of pebbles, or of fragments, or of sand of primeval origin, compacted and cemented by an argillaceous, or calcareous, or siliceous cement, of posterior origin; hence they generally form the lowest stratum that separates primeval rocks and secondary strata. From their composition, they come under the denomination either of farcilites, brecias, or sand-stones. In some places this sand has been accumulated into vast heaps, so as to form mountains 6 or 700 feet high, and then compacted by an adventitious cement. Of this sort are the mountains of Hertzberg and Kaulberg, near Ilefeld, in which the sand is cemented by a ferruginous cement, and contains fragments of porphyry, and al iron-stone, and manganese, and strata of c impressions of reeds, rushes, and ot Lasius, 249 and 280. The red colour is from iron.

"The semiprotolite of Wartburg, near I contains rounded lumps of granite and mica: substances found in the neighbouri tains. The semiprotolite of Goldlau r entirely of porphyry, as do the primeval tains of that district. That of Kiffhau g Thuringia, contains rounded argillites fi neighbouring mountains of the Hartz. P wood is found in this last, Voigt's l s, 20. According to Voigt, the semi under coal has a siliceous cement, few primitive stones; Lettres sur les l 31. Saussure made the same observa which he found on the descent of Trie interceded between the primary and mountains, 2 Sauss. § 699. He even long before, that primeval and sec ary were almost always separated by a r farcilite, 1 Sauss. § 594. Where the seco strata are calcareous, the semiprotolite l careous cement; see Lehm. 168. Semipr is always red, by reason of the ferruginous ticles by which it is cemented; its diffi xpansion is unequal, being frequently horizontal r even, but sometimes depressed, and in other nstances much elevated. Most of the supermposed strata partake of this inequality, and are its natural consequences. Hence the protuberances and depressions, otherwise called moulds, observed in them; Charp. Saxony, 371. It rests on granite, Ibid. 370, 371."*

Mr. Jameson informs us that in the Hartz it rests on grauwack, and extends nearly round the whole of the country; nay, through Saxony, Hessia, Bohemia, Silesia, and Franconia. The red sandstone of the north of England, which is micaceous, and often regularly schistose, so as to form pavements, &c. seems also to belong to this formation. As the substance is widely spread and highly remarkable, the barbarous denomination may be exchanged for that of Lasite, in honour of Lasius, the celebrated describer of the Hartz, who has ably illustrated this substance.

Lasite, of various kinds, from Germany, of which there is a series at the College des Mines, in Paris, where it was shown to me by Daubuisson.

The same, from the north of England, &c. &c.

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* Kirwan Geol. Essays, 256.

Aspect 2. Ferruginous sand-stone, brown, with glandules and veins of colour, from Mont Calvaire, near Pa is frequent in ferruginous sand, pr from its decomposition.

A ferruginous sand-stone, r
Kirwan, forded 19 parts
T *E* , iron -st
n l is

of ferruginous sand-sto n ii
Dietrich, as already mentioned, t
sand-stone is as primitive as granite E

---

* Dietrich, Sivry, &c. Saussure says, § 699, that the deadlyer of the Germans, or rather deadlayer, is a pudding-stone.

Mont Blanc

DOMAIN II.

SILICEOUS.

◆

SILEX, SILICA, OR SILICEOUS EARTH.

IS earth derives its name from the
x, or flint, in which it abounds. Some
denominate it quartzose earth, be-
se it is perhaps more abundant in the
e called quartz, which, when trans-
nt and crystallised, is styled rock crys-
It so frequently occurs in the form

of sand, which covers a great part of the globe, either alone or mixed with clay, that late chemists infer that such sand arises not only from the decomposition of rocks, but is often a disturbed or hasty crystallisation of silica*. This is further confirmed by the circumstance that many primitive tains consist of granular quartz, of a ceous appearance, like agglutinated sand.

The stones now called siliceous, were formerly denominated vitrifiable; because, with an alkali, they may be melted glass; and the finest Venetian fabricated from quartz, by the I called *tarso*†. Silica, like the other ple earths, is a fine white powder; but particles have a harsh feel, like mi sand. Alone it is scarcely fusible; when newly precipitated, is soluble in 1 parts of water.

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* The purity of this term may be doubted. *A* lous, being the plural of *alumen*. In the fabrication of grammatical precision ought always to be studied.

† In the Phil. Trans. 1683, Dr. Lister says *tars* sand of which the fine Venetian glass was made. The nious author there proposes, p. 739, Mineral Maps he calls them.

ned with iron, argil, and magnesia, it tutes the primitive and most important cks, rising to the regions of perpetual and thus supplying unfailing aliment great rivers that fertilise the earth. considered in these mountains, in and in clay, it may be pronounced ost abundant of all the earths: and form the nucleus, the shell of this may be said to consist chiefly of It is suspected that it is coeval timately connected with iron; as the tes or meteoric stones, and the large s of native iron, discovered in Siberia outh America, contain abundance of mixed with some magnesia*.

ceous substances generally strike fire teel; and flint or quartz yields a pe- odour, supposed by some to arise a subtile substance which chemistry ot been able to discover. A strong horescence is also produced by col-

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ysolite, a mixture of silex and magnesia, is always found in n. The exclamation of Henkel is well known:

O silex! silex! quæ te matercula gessit?

lision, so that, during Alpine hurricanes, the torrents, rolling large fragments of rock, present a singular scene of corruscation.

MODE I. QUARTZ.

Distinctive characters.

Texture, compact, generally uniform, times granular, rarely laminar, in which the lustre is generally dull.

Hardness, crystallic. Fracture, y, such as sometimes to resemble the Fragments, very sharp.

Weight, granitose.

Lustre, glistening or shining, someti tuous. From transparent to opake.

Colour, generally white; sometimes br grey, yellow, red, or black.

It sometimes composes entire m abounds in those of granite, in which it is seldom crystallised.

STRUCTURE I. COMPACT.

Aspect 1. Opake. A very com but the specimens of entire mountains e

Sites.

"The mountain of Kultuck, on the end of the lake Baikal, 350 feet high, long, and still broader, consists entirely of hite quartz: per Laxman, 1 Chy. An. 1785, 55. Also Flinzberg, in Lusatia, almost entirely. Berg. Jour. 1789, 1054. There is also an exensive narrow ridge of quartz, some miles long, Bavaria. 2 Berg. Jour. 1790, 529, &c. Flurl avaria, 309. Monnet mentions a rock of quartz 0 feet high. 17 Roz. 163. Mountains of it also ccur in Thuringia. Voigt Prack. 69. and in Sisia. Gerh. Beytr. 87. and in Saxony. 1 Berg. our. 1788, 269. and in layers between gneiss nd slate mica. 2 Lenz. Also in Scotland. 2 ms. 52. It is not metalliferous. Werner Kurse lassif. 15. Petrol is often found in it. 1 Berg. our. 1791, 91. The mountain of Swetlaia Gora, nong the Uralian, consists of round grains of uartz, white and transparent, and of the size of pea, united without any cement. 2 Herm. 278*."

Mountains of quartz also occur in Scotland, here, from the white substance, they sometimes pear as if covered with snow. A hill of this nd is seen near Cullen, which supplies glassorks at Newcastle with quartz. The mountains f Scuraben and Morven, in Caithness, are chiefly nstituted of this substance; which also, accordg to Mr. Jameson, occurs in great quantity in e islands of Ilay, Jura, and Coll. There are so large rocks of quartz in Upper Lorn. Buffon says*, there is in Auvergne, near Salvert, a vein of quartz 10,000 fathoms in length.

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* Kirwan Geol. Ess. 179.

In the Uralian mountains it sometimes happens that there is an entire mountain of quartz, another of felspar, and a third of talc, thus presenting the materials of granite on a very large scale.

Aspect 2. Semi-transparent. This s
forms very extensive veins, but perhaps n
stitutes an entire hill or rock.

Aspect 3. Unctuous. This also appears
veins, and generally accompanies metals.

STRUCTURE II. GRANULAR.

This kind often constitutes entire r
Scotland, and other parts of the wo
sometimes been confounded with silice
stone, but late writers have demonst
may be owing to a primitive but distur
lisation†. Nor is it inconsistent that
cement was deficient or interrupted,
appear among the most ancient subst
shape of mere sand. The grains, as r
tioned, are sometimes of the size of

---

[*] Min. i. 100.

[†] Collate however the account of the Siliceous Mode XIV. Str. 2.

Grey granular quartz, from Balahulish, in Scotland.

The same, with veins of white semi-transparent quartz, from Bunessan, Mull.

Saussure describes, § 999, rocks of a beautiful granular quartz, which rises in leaves of a rhomboidal form. It is very hard, and has the grain and whiteness of statuary marble.

Veins in lime-stone.

He also observes, § 2235, that in primitive limestone there are often veins of quartz, as there are also veins of keralite or hornstein in compact limestone. Query, if both the latter substances do not contain more argil?

Mr. Playfair observes that granular quartz is common in Scotland, alternating with schisti, particularly on the north side of the harbour of Balahulish, and on the sea-shore at Cullen. He also shows that sand is a crystallisation; and mentions a siliceous grit with no cement*.

In Buckinghamshire, Wiltshire, and Dorsetshire, where there are only sand and chalk, there is found in the sand a prodigious number of large blocks of granular quartz, which is used for paving or building. The castle of Windsor, and the terrace, are built of this stone, probably from the forest, or the neighbouring heaths, where there is a great quantity; and Stonehenge is b blocks. So blocks of granite are found in] denburg, Mecklenburg, and Pomer *.

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* Hutt. Theory, 27, 171, &c.

Mountains of granular qu z land; and granitic mountains S the continents were gradually emerging, these large subsidences which form r seas, it may easily be conceived that where such blocks, and gravel foreign rounding mountains, are always found, vered for ages by the waters of t rolled these blocks and gravel in the their currents.

In a late volume of the Pl actions†, Bournon gives some different modes of attraction, whi formation of minerals. The att gation are either simple or crys l

" It sometimes happens (more considerable degree of ur the process of attraction), that small irregular detached masses, o as to be scarcely perceptible; at are of a larger size, and, as soon as for the bottom of the liquor, and unite

---

* De Luc, Geologie. Paris 1809, 8vo. p. 332.

† 1804, p. 37.

mple mode of attraction, which may with great ropriety be called *simple homogeneous attraction* *aggregation*. Of this kind are, granulated uartz, granulated carbonate of lime, &c. the different kinds of which substances differ from each ther only by the fineness or coarseness of their rain."

Sometimes this takes place along with the crysalline, whence small crystals, &c. Sometimes he molecules are precipitated in a detached but onfused manner, so as to form earthy or compact ubstances. In aggregate stones there is the ttraction of aggregation, as in granite, sandstone, and others.

But long before, Mr. Kirwan* had made the following observations:

"The first step in the process of crystallisation is the formation of grains; the second is the increase in one dimension; the third in two dimensions; and the fourth in three dimensions: the grains themselves, however, to be visible, must receive accretions in the three dimensions. If the process be uninterrupted, no traces of distinction will be perceived, and the whole will appear perfectly uniform; but, if it be disturbed in the first step, no crystallisation can take place; if in the

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* Min. i. 21, edit. 1794.

second, the grains will appear distinct,
gross, coarse or fine, according to t
the disturbance, whether by the interru
process, or the accession of foreign ter;
latter generally produces coarse or r
proportion to the quantity.

"If the disturbance only takes pl
third stage, we shall have fibres or st
plete surfaces cannot be formed; the str
more extension in breadth than the f
ments, argue a smaller degree of distu
the mere fibrous appearance.

"If, during the third stage, the st
into contact by the gradual derelic
that kept them suspended, they
in proportion as they are deserted,
either adhere to each other, and t
fusedly, being too heavy to be su
menstruum, or, if supported, will be su
on each other.

"But if the process of crystall
turbed only in the fourth stage, then
shape only of the crystals will be
altered.

"All these steps are noticed and described by chemical writers; and particularly by the celebrated Rouelle, in the Memoirs of the Academy of Paris on the crystallisation of salts."

STRUCTURE III. LAMINAR.

This is generally dull, and approaches to the ext Mode, keralite, or rock-flint. The layers are ommonly thin, that is, from a quarter of an inch an inch. It forms a hill near Bamf. Saussure, 1483, has described a black schistose quartz, which may be a siliceous schistus of the Ger- nans.

The cellular, stalactitic, fibrous, and other structures, seem to occur only in small portions, and rather belong to lithology or gemmology.

MODE II. KERALITE, OR ROCK-FLINT.

Characters.

Texture, compact and uniform, but sometimes laminar.

Hardness, crystallic. Fracture, splintery, conchoidal: the scaly fracture distinguishes it from flint. Fragments, sharp.

Weight, granitose; sometimes, but rarely, carbonose.

Lustre, dull. Opake; but often translucent on the edges.

Colour, grey, black, green, &c.

It composes entire mountains.

Hornstein.

This rock is the *hornstein* of the Germans, Petrosilex. and the *petrosilex* of their writers in Latin; has of course been confounded with the silex of the Swedes and French, which is c pact felspar. To avoid this confusion the C term keralite has been adopted, from L Keralite is not fusible by the blc pi compact felspar generally is. It is found impregnated with metals, while c felspar or felsite has perhaps never been to attend metals. Felsite also presents t rious colours of felspar; while ke passes from white, through grey, to It may be regarded as an impure q shares the sites and properties of t

In England it is called chert, in veins or layers through lime-stone, larly in Derbyshire.

STRUCTURE I. MASSIVE.

Aspect 1. Common. Bluish grey sometimes mamellated, and approachi cedony, from the lead-mines of Bre is properly a vein-stone; and Brongn t served, i. 355, that such are *hornste* , appearance be waxy, as they are infusi spar or felsite rarely appear as vein-st

Of a lighter grey, with blende the same.

With different laminar shades of black, but not ith a laminar fracture, from Giromagny in the osges mountains, France*.

Interspersed with native silver, from the famous ountain of Schlangenberg, or Zmeof, in the south Siberia, which seems entirely to consist of rock-nt, mixed with silver.

From the great oriental chain of mountains in beria, where, according to Patrin, it underlays e ribbon jasper.

With crystals of felspar it forms what Werner yles hornstone porphyry, for which see the Si-ceous Intrites.

Aspect 2. *Unctuous.* There is also an unc-uous keralite, like what is called fat quartz. It s sometimes mistaken for felsite.

STRUCTURE II. LAMINAR.

Siliceous schistus.

Aspect 1. The *siliceous schistus* of Werner, a term very vague, as there are so many schisti of a siliceous nature, is by Mr. Kirwan and others regarded as a schistose hornstone. It is a primitive rock, usually of a greyish black, intersected with

---

* In another work the author has said that, in the ancient phraseology, forests and mountains were often confounded. Roeslin *de Sylva Vasgovia* (that is, an account of the mountains of Wasgaw, or Vosges) is a modern example.

small veins of white quartz. Of this the basanite, or Lydian stone of Werner, is accounted only a diversity; but many regard it as a black jasper,
and as all the jaspers are impregnated
it would be truly surprising if there were
jasper. According to Mr. Jameson,
slate of Werner not only occurs in c
beds in primitive slate, but also, like q
entire mountains.

It appears by the French writers
sometimes confounded with a fine tr
Latterly siliceous schistus has been
present various colours; and when it
grauwacke slate, is regarded as a t
The primitive is said to underlay t
Mount Sorel, in Leicestershire.

Chert. *Aspect 2.* The *chert* of the E *
occurs in layers in lime-stone, and
stitutes a mass of petrified shells.

Dark grey chert, with lime-stone, from Derbyshire.

Reddish chert, with lime-stone, from F

Brown chert, full of petrified shells, f
byshire.

In bowls, with concentric layers, br
grey, from Vaucluse. Saussure, § 1546.

---

[*] *Chertz* of some counties, which seems related to quartz.

MODE III. FELSPAR.

Characters.

re, strait, foliated.
ess, of course felsparic. Fracture, la-
Cross fracture, fine-grained, uneven,
hing the splintery. Fragments, sharp,
omboidal.
ht, granitose.
nal lustre, shining; of the cross fracture,
ing, glassy, sometimes pearly. Trans-

r, many varieties of white, grey, green,
rarely blue or black.
n composes mountains, especially when
rsed with mica; and is the most abundant
ce in granite, where it often forms distinct
*.
are mountains and large strata of fel-
he north of Scotland.

---

ometimes classed with the Argillaceous, because some
npose into clay; yet this effect probably arises from the
ut it forms the chief part of granite, which has never
l among argillaceous substances.
g to Lametherie, v. 9, felspar requires the most water
, so must be the most ancient; and is followed by horn-
rtz, mica, magnesia, and the metals successively. But
rosilex of Vosges is a felsite. Ib. 352.

STRUCTURE I. COMMON.

Aspect 1. Common foliated. This rarely entire mountains, but such have been in Siberia. When it forms moun rally white.

Aspect 2. Granular. Rocks of fi granular felspar, resembling statuary dolomite. Sauss. § 2144.

Aspect 3. Unctuous. Saussure, § scribes what he calls *felthspath gras,* felspar, as having a visage more oily lucent than common felspar: the f laminar; and the plates, when percei being level, but often convex, so t the fractures are generally conchoidal. It and less fusible, than the common.

STRUCTURE II. MINGLED.

This division may justly co rocks and entire mountains, consi interspersed with a little mica or quartz, garnets; the preponderance of the fels great that they cannot be considered as

:s may be said to be always white, like
isting of felspar alone.
rock, with a few garnets, from a moun-
west of Scotland.
ne, lightly sprinkled with mica, from the

Petuntze. ne, with a few grains of quartz, *Petuntze* inese, from Limoges, in France. The lain of Sevre is composed of this sub- quartz being carefully separated. The lso found in Cornwall, Saxony, China, other countries. When the felspar is

Kaolin. d into a white clay, it is called *kaolin,* necessary in the fabrication of porcelain. utiful opalised kind of felspar, called

Labrador. stone, is also a component part of rocks and Norway, where it only reflects the ; both kinds, when viewed alone, with

Green of Siberia. ful green felspar from Siberia, falsely Amazon's stone (which was found near f Amazons, in South America, and is a r belong to gemmology, as they do not entire rocks. But the Labrador and n rocks, considered as a compound, are d in the Anomalous Domain.

MODE IV. FELSITE, OR COMPAC FELSPAR.

Characters. Texture, compact.

Hardness, felsparic. Fracture,
liated. Fragments, rather sharp,

Weight, granitose.

Internal lustre, glimmering,
Translucent, sometimes only on t

Colours, various, as of felspar,
distinguish it from keralite. M ts
blow-pipe.

It is doubtful if it form entire
is an important rock, and among t
mitive.

Palaiopetre. It is the *Palaiopetre* of Saussure,
near the summit of Mont Blanc;
men which he sent to Lametherie,
have seen, is compact felspar, easily
the blow-pipe.

Petrosilex of Wallerius. It is the petrosilex of Wallerius,
quence of the Swedes and Fren
must be carefully distinguished fr
silex, which literally implies the rock
Germans, being a modification of
not of felspar. The name felsi

introduced by Mr. Kirwan; as a distinc- between it and keralite seems first to have n from an accurate examination of the tiful blue granite, discovered near Krieglach ria, where it occupies the place of common r. The distinction, which is thus recent, an important step in the knowledge of

allerius sent a specimen of his petrosilex to ce, which I saw in the possession of Haüy, rose-coloured compact felspar, from Sal- Saussure mentions a grey felsite, explored lates near Martigny, in the valley of the e; and the celebrated cascade of Pisse e falls from a rock of this kind*. His jad o now called compact felspar. Patrin† saw iberia, near the celebrated silver-mine of of, a mountain with singular natural forti- ons, composed of felsite. They rise about eet above the body of the mountain; being

1046. Between Martigny and St. Maurice there is also a sin- ariety of rocks. Among them is a kind of petrosilex, grey, nd sonorous, with a little transparency, which rises in thin perfectly flat and regular: hence it is used as a slate-quarry. obably of the same nature with patrinite, or laminar felsite. ck of the famous cascade called Pisse Vache, seems of the ind, but approaching nearer to a feljad, greenish, and semi- ent. It melts like a felsite, but with greater difficulty. 134.

on all sides as steep as a wall, and only pierced with a few difficult openings. The summit forms a platform, about 500 paces by 200, covered with blocks and fragments of various kinds of felsite, some laminar, others veined in zigzag. Some have the triangular form of half a cube, cut by its diagonal; and one large mass is composed of angular fragments of felsite, in a paste of the same substance, so as to constitute a bricia.

When Dolomieu wrote, the knowledge of rocks was far from having attained even the present degree of precision; which is however so far from being perfect, that perhaps another enlightened century may elapse, before all the rocks shall have been discovered, analysed, and examined, so as to be reduced to their proper domains and modes. The following rock, with a base of his petrosilex, which is felsite, probably belongs to this division, though he mentions it after the toad-stones and variolites*.

Felsite of Corsica.

"I must here mention some glandular stones which I found in Corsica, chiefly in the valley of Nido†, and which have petrosilex for a base; none have appeared to me more curious nor more instructive. The very fine paste, which forms the ground of the mass, is of different olours, white, grey, red, or brown. The glo- ules, whose growth may be traced from the stant when, having a diameter of half a line, ey begin to be apparent, till they have acquired n inch in size, are generally black, with an pect of horn, sometimes brown or red, but ways of a different colour from the base: they e striated from the centre to the circumference, id have almost always a small crystal of fel- par, or a grain of quartz, for a central point. ometimes the gland is not completely formed; s place is only marked by the circular spot ound the central grain. The greater part of ese glands adhere strongly to their base, per- ctly incorporating with it: some, but not those hich are striated, may be detached, and leave heir impressions. It seems to be a mixture of teatite which favours their separation. These lobules, which are not always harder than the aste which contains them, are affected by fire ke petrosilex; and only seem to differ from heir base by the kind of texture that a peculiar ggregation has caused them to assume."

---

* Journ. de Phys. 1794, p. 260, note.

† Niolo?

Dolomieu, following the observations of Saus- re, § 1079, has demonstrated*, that the petro- lex of the Swedish and French authors is a compact felspar. It is sometimes of a gre hue, from a small quantity of steatite in its paste; and sometimes grey or black, a mixture of bitumen, as Dolomieu arg its becoming white before it melts. Fels passes into felsite, and the latter often c little scales or crystals of the former.

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* Journal de Physique, new series, vol. i. p. 244.

Two kinds of felspar.

This ingenious, but prolix and author, distinguishes two kinds of f which contains lime, and that which c magnesia. The latter is more hard and less fusible than the other; proaches to the nature of jad, might, plex term, alike useful for precision memory, be called feljad. Some g both kinds, but felsite generally c it is also found with crystals of schorl, siderite, or veins of quartz.

Feljad.

According to Dolomieu, felsite fo of several porphyries found in the Niolo, in Corsica. One kind is gre fine as chalcedony, sprinkled wi number of red dots, being little cr spar. A brown felsite porphyry, of kind, is used for slates in the village of I in the bishopric of Trent.

"The mountains of Tyrol, between Tr Bolsano, are almost entirely composed yries, with a base of petrosilex of different ts; and the little valley of Fierrozo, in which ws the river Fersina, and at the entrance of hich is the village of Pergine, might be called e valley of porphyries, from the infinite numer of varieties which that rock there presents, ways preserving the same base. There are ey, green, red, brown, black. There are some milar to bricias, of a green cement with pieces f other colours. The petrosilex in it gradually sses to the granitic texture, and to the state of histose rock, without the beds changing their rection."*

STRUCTURE I. COMMON.

Rose-coloured felsite, from Salberg, in Sweden. This is interesting, as being the petrosilex of Walerius, which led to many errors of the Swedish nd French writers. He describes the following inds†.

A scaly grey petrosilex, from Salberg.
A scaly brown, from Garpenberg.
The red scaly petrosilex, from Dalecarlia.
The green scaly petrosilex, from the same.
The blackish scaly, from Dannemora.

He then describes several specimens of a waxy

---

* Ib. 247, note.

† i. 280.

fracture; and observes, that his p
times runs in layers in calcareous mo
that he has confounded the seco y
with the primitive felsite. When
into jasper, it must properly
rock-flint, which, like jasper,

STRUCTURE II. LAMINAR.

This kind is observed by Saussure mentioned. It has been confounded keralite or hornstein.

Klingstein. The clink-stone of Werner, s lously called *basalte en tables* by the neralogists, may properly be classed division, as having no connexion with modes, which are characterised by of iron, but most intimate re as will appear from the f Vauquelin and Klaproth:

	FELSPAR.	KLINGS
Silex	62,83	
Argil	17,02	
Lime	3,00	
Potash	13,00	Soda
Iron	1,00	(manganese 0
Loss	3,15	(water 3)
	100	100

Klingstein porphyry.

The klingstein porphyry of Werner, which he lso absurdly calls porphyry slate, is a schistose elsite, with crystals of felspar; as it happens in many substances that an earthy and compact base s spotted with crystals of the same substance, the orms of some of the molecules having disposed hem to crystallise, while the others became sedimental. The klingstein porphyry is generally black r grey, but sometimes of a green, yellow, or brown tinge, like the klingstein, which seems to dmit most of the colours of felsite; but is of a chistose texture, and contains little cavities, often ined with quartz crystals, much resembling lava with a basis of felsite.

Patrinite.

As the French seem first to have observed this ock, it may be called patrinite, in honour of Patrin, an eminent French Geologist and Volcanist. It sometimes contains zeolite, calcareous spar, and crystals of siderite. Mr. Jameson has observed hat it is sometimes vesicular*, or full of little cavities, "but not so much so as basalt." Part of his description of patrinite may be transcribed.

Jameson's description.

"2. It occurs sometimes in tables and columns; also in veins that traverse sand-stone and greenstone, as in the island of Arran.

"3. It resists the action of the weather very obstinately. After very long exposure it becomes covered with a thin crust, which has usually a greyish-white colour, but a reddish crust in iron-shot varieties.

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* This epithet seems only applied to basalt, wacken, klingstein, lava, pumice.

"4. Like basalt it forms single conical but they are not so regular, and are more with cliffs and irregular rocky forms.

"5. Excepting small traces of iron-pyrites, and iron-sand, it contains no ores.

"6. It appears from observations I in the islands of Arran and Lamlash, in shire, and on the porphyry-slate hills burgh and Haddington,. that this rock the one hand, into compact felspar and and, on the other, into pitch-stone and

"7. It occurs abundantly in the isla and Lamlash, in the frith of Clyde; also quantities in the upper part of Dun and in the county of Selkirk. B part of the Pentland hills, near Edinb Girleton hills at Haddington, and, acc my pupil Dr. Ogilvy, North Berwick Traprain or Dumpender Law, in the s are composed of this rock. I suspect porphyry of Cumberland, which probably among transition mountains, is also p slate. It occurs in great abundance in B also, but in less quantity, in Lusatia; in the p

ality of Fulda; in the Rhongebirge; at Hohen-
el and Hogau, in Upper Suabia; at Vicenza,
the Euganean mountains; on the Pic de Teyde,
Teneriffe; and in great abundance in South
nerica, as I suspect that much of the porphyry
Humboldt will prove to be porphyry-slate."

It may likewise be observed, from Brochant's
cription, that patrinite sometimes occurs in globar masses, implanted in other rocks; and also
netimes assumes the prismatical form, in groups
nore or less regularity.

To these remarks may be added the curious
cription by Klaproth, which accompanies his
lysis.

Klaproth's account.

'The schistose-porphyry is a species of stone,
ich, notwithstanding that it so frequently occurs,
l even in masses forming entire mountains and
:ks, yet was doomed by a singular fate long to
ntinue to be disregarded, unknown, and con-
nded with other stones.

'The first denomination, under which it has
en admitted in oryctognostic treatises, is that of
rnschiefer (horn-slate). However, this name
es not exclusively belong to it; for which reason
ious authors denote by the same name several
erent species of stones. This German deno-
nation seems to have been occasioned by the
in *corneus fissilis* of *Wallerius;* though it is

obvious from the description which
of his *corneus fissilis*, that he
nify by that name our schi y,
as it seems, he did not know, t
schiefer (hornblende-slate of K

" Other authors, as Born, Fer ,
this name, sometimes different
thonschiefer (argillaceous slate),
glimmerschiefer (micaceous slate).

" The first oryctologist who
attention of naturalists to t
and given of it an accurate descri
pentier, in his Mineralogical C
Electoral Dominions of Saxony. At
time he gave to it exclusively t
slate, in which he was followed by
man mineralogists. But Wer
wise. He left this name at first to
stone, which afterwards has been
chiefer (siliceous slate); and
which is the subject of the present
porphyry, in order to distinguish it
species of porphyry. In fact, it exh
neralogical character of porphyry:
pally consists of an homogeneous,
and argillaceous aggregate, in
sparingly, and singly, are interspe
mellæ of feldspar, besides minute g

blende; yet at the same time it is distinguished from the common species of porphyry, by its gross slaty fracture. But since to the principal mass of this stone the name of *klingstein* (soundingstone) has been given, because its larger plates, when struck, give a sound almost metallic; it seems that the name of *klingstein porphyr* (klingstone porphyry) would be more characteristic, and more conformable to analogy.

"From this short historical account it may sufficiently be seen, what great uncertainty and want of accuracy has even of late prevailed in the geological knowledge of the mountainous part of the globe. For this reason the editor of the magazine for the Natural History of Swisserland has highly merited the thanks of the public, for having occasioned, by means of a prize-question, that this intricate subject has been investigated by two learned mineralogists, Karsten and Voigt, and correctly explained in their two papers, crowned with the prize: "On argillaceous schistus, horn-slate, and on wake*."

"The klingstone-porphyry belongs to that division of mountains which, by modern geologists, are classed with the trap-mountains*. In G it occurs chiefly in the middle mountains of] mia, in Upper Lusatia, and in the district of] da. It does not form coherent ran tains, but always only detached ma: s of r and insulated mountains, commonly t of similar basaltic mountains. It bel most durable *saxa*, and resists the wit eminent degree. Only on its surface takes place, by which it acquires a crust, the smoothness of which renders sion on klingstone-porphyry moun unsafe. Some of these mountains, sparingly covered with fertile soil, are well invested with plants and forest e instance the Donnersberg, near Mi the Schlossberg, near Töplitz. But r quently the klingstone-porphyry occu shape of cliffs, which are dentated in manner, from the unequal, mostly v nto large plates and ill-formed pillars. of such grotesque rocks, are the Biliner- Belin, and the Engelhaus-berg, not far bad.

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* "Magazin für die Naturkunde Helvetiens," by Dr. Höpfner. Zürich, 1788. Vol. iii. page 168, seq.

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* In the German *trapp formation*. This exp according to Emmerling, by the latest German mine to signify all mountains constituted of grünstein, am tose-porphyry, basaltes, and their subordinate sp are called *trapp-gebirge*, since those *saxa* not only oc tains of the same kind, but also very much in gnostic relations; so that evidently they are of the Transl.

mplete the history of this stone, I must ce an opinion which has of late been in l even now seems to have its abettors. at the klingstone-porphyry, as well as , the amygdaloid (mandelstein), and mountains, have been considered as roductions, or lavas. It does not be- e object of the present inquiry to repeat mine what on both sides of the question argued, and sometimes with violence I shall only mention, that in the se- tive inspections with which I examined, ddle mountains of Bohemia, the sites of d klingstone-porphyry, I could not dis- least vestige of a crater, or other signs nic nature; no more than any other un- l observer would have been able to find. hese short geognostic remarks I shall the description of the external characters ass, which chiefly constitutes the kling- phyry.

colour of the klingstone is grey, now and ttle inclining to the green. It occurs ssive. It has a fine grain, an uneven, coarse-splintery, fracture, and bui slaty fragments. The edges of its tl fragments are transparent. It y at the same time considerably t triturated, it yields a light grey

"Its specific gravity is 2,575.

"The lamellæ of a greyish splendent felspar, which are in substance, together with the very of a black hornblende, give to it the porphyry."*

The result of the analysis is—

"Silex	57,25
Alumine	23,50
Lime	2,75
Oxyd of iron . . .	3
Oxyd of manganese	0
Soda	8,10
Water	3
	98,10

"The reflecting natural p without my suggesting it, h value of this discovery of the a constituent part, in a stone w masses of the size of entire mo him a new view, and leads him a long step rther in his geological inquiries. We now see at there is no longer any occasion for the theory itherto prevailing, according to which it was ima-ined necessary to consider all the soda, which in ature occurs either in a free, that is uncombined, r in the carbonated state, as an educt arising from decomposition of rock salt, or of sea salt, or of hat from saline springs, supposed to have been arried on by nature, and to have taken place in n unknown manner.

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* Klaproth Anal. Essays, ii. 182.

"The klingstone employed in the preceding ex-eriments was from the Donnersberg, near Mille-chau, the highest of the middle mountains in ohemia. The whole mass of this majestic cone, hich is above two thousand five hundred feet igh, consists entirely of this stone. From its ummit the picturesque fields of Bohemia, extend-g for many miles around, present themselves to e eye, collected as it were in a pleasing minia-re painting; while at the same time, at a farther istance on the eastern horizon, the Bohemian and ilesian Giant-mountains, and on the west the ranconian Fichtelgebirge (mountainous region), e discovered.

"If we now reflect, that in this enormous mass rock, the soda constitutes nearly the twelfth rt of the whole, I hope it will not be thought an exaggeration to say, that this mountain alone is pable of providing, for a long successi of y to come, all Europe with sufficient s supposing, however, that expedients s devised to separate this alkali from the st by cheap and profitable method*."

STRUCTURE III. EARTHY.

This is described by Saussure as of an earthy or granular appearance, with long and im crystals of black siderite, sometimes The rock was mistaken for a sand-stone. mentions, § 1136, a rock of a violet red, conceives to consist of the earth of crystallised.

Earthy klingstein-porphyry, from Mont Dor, described by Daubuisson in his account of the basalts of Auvergne.

The following varieties may also be the former great petralogist:

Rocks of felsite, with veins which be taken for granite, but upon exan found to present only felspar and mica, times only felspar confusedly crystallised. § 1194.

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* Ib. 193.

ck of green and violet layers, being a kind
te. Sauss. § 1448.
at he calls a trap, with a paste of a greenish
elsite, and grains of quartz and felspar.

58. The rotten-stone of England may be
d as a kind of tripoli, but is neither porous
a slaty structure. He concludes that tri-
nsists of a fine sand of felsite.

Rotten-stone.

MODE V. GRANITE.

important substance, which composes
ghest chains of mountains, and was used
Egyptians in the earliest monuments of
chiefly composed of felspar and quartz,
have been already described: a third sub-
is also indispensable in granite, namely,
mica or siderite. And even when both
latter are joined, the most exact mineral-
or geologist could not refuse the strict ap-
ion of granite, as different mixtures may
und in no very remote parts of the same

Composition.

As some granites, instead of felspar, pre-
elsite, yet are universally admitted into this
; so the mica may pass into talc or steatite,
lerite, as on the summit of Mont Blanc, and

the siderite into iron, without changing denominations. Crystals of schorl, or garnets, not to mention the precious stones, may also appear in genuine granite; but the real and severe denomination can in no case be further extended.

Granitel.

When there are only two essential substances, with a granitic appearance, as particularly quartz and felspar, the term granitel must be admitted, with Saussure, Kirwan, and other celebrated geologists; though in Italy *granitello* is used by artisans for a complete granite, composed of very small grains, here called *granitin*; as basaltin is a fine basalt, and porphyrin a fine porphyry.

These observations become the more necessary, as no substance has engaged more attention in systems of geology, and no two authors seem hitherto to be agreed in precise and formal definitions of granitic substances: and in all sciences it is well known that no question can be settled, or even accurately discussed, without the most precise definitions. Thus in the question concerning the entrance of granitic veins into primitive schisti, some deny that the granite in these veins is of the same mixture with the mass; and it certainly would considerably influence the discussion, if the mass be a complete granite, and the veins only granitel. Nor in

ct can there be any just science, if terms be
ed in a lax acceptation; and it is far better
err in the contrary extreme, which can only
e accomplished by increasing the number of
istinctions and denominations, as has been done
gemmology.

Granite, with siderite.

As siderite has been shown to be among the
ost primeval substances, and is found enclosed
the crystallisation of the most ancient gra-
ites, so as to evince a priority of formation to
he quartz, or the felspar, which never appear
be intercepted by the siderite; so it may be
ssumed that a granite, consisting of felspar,
uartz, and siderite, with or without the addition
f mica, may be regarded as among the most
ncient, if not absolutely primary. Saussure
bserves that there is no mica in the granite on
he summit of Mont Blanc, its place being sup-
lied by siderite; and remarking the same dif-
erence to occur in the granite ejected from the
epths of the Italian volcanoes, he is led to the
easonable conclusion, that this construction,
eing found at the greatest heights and the
reatest depths, must be the most primordial.
t is also remarkable, that as the nucleus of the
arth is inferred by astronomers and natural phi-
osophers to consist of iron, which is seldom
ound free from silex, so a great part of the sum-

mit of Mont Blanc consists of granitel*,
mixture of felspar and siderite; and
all lavas consists of one of these two
Whether however we join the Hu
considering granite as the newest
last ejected from the bowels of the
Wernerians, in regarding it as the
being deposited from above, we must
to view a substance composed of fe
and siderite, as not only a complete
granite, but as perhaps the most
nation of that class.

As Mont Blanc is the most r
nitic mountain in the world, it may
to translate Saussure's curious a
account of its summit. Of the ro
great observer discovered near t
mountain, he gives the following
which shall be followed by that
observed on the summit itself†.

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* This, as Saussure especially mentions, § 1994,
of Werner at the time when he wrote, A. D. 1
about the same period defined the syenite of We
quartz, siderite, and felspar. Jameson however
composed of felspar and hornblende; but Kirv
Karsten. Daubuisson, who is commonly exact, says
composed of felspar and siderite; and that any q
accidental.

† Saussure, § 1999, supposes that the summit of
was originally about two leagues under the surface of

Summit of Mont Blanc.

. “ The naked rocks that we there meet
and which form two kinds of *arretes* or
of a black colour, and somewhat saliant,
we clearly see from the banks of our lake
eft of the highest summit of Mont Blanc,
anites,* here detached in scattered frag-
there, in solid rocks, divided by fissures
vertical, whose direction is conformable to
ich generally predominates in these moun-
that is, from the north-east to the south-
nd which I consequently regard as layers.
he felspar which enters into the compo-
of these rocks is white approaching to
or green, or redish; it yields under the
ipe a glass, from which we may obtain
es of 0,6, transparent, colourless, but full
bles.

he felspar is here pure, there covered or
nixed with a substance of a grey, inclining
ea-green, colour; without lustre, earthy,
when scratched, whitish grey. This sub-
appears to be an earthy steatite; it is
lt to obtain pieces of it free from felspar;
that I separated, melted under the blow-
nto a greenish glass, translucent, and of a
nctuous aspect. They became discoloured
iron rod, and dissolved with effervescence.
he whitish, semi-transparent quartz, which

enters into the composition tl g
pears a little unctuous in
ment; of the fifteenth of a li lo
in thickness, or of 0,067 by 089,
extremity of a thin rod of ir ,
rounded in the flame of t
little of its transparency, h
appeared perfect, and some but
interior. This quartz is then !
than rock crystal, in the propor
0,014.

" These granites are frequently
hornblende, here blackish, the
green.

" There is also seen chlorite, often
ish green, sometimes in veins, some
and even in pretty thick masses. It
not friable; of a very fine grain;
particles, viewed by the microsco
translucent thin plates, of a br ;
they have not the regularity of
Gothard, which I have descri
This fossil, like hornblende, ap
these granites the place of mica, whi
appear in it, except in very small
spangles.

" Some of these granites app t
being small cavities of angular

s, full of a rust, or brown dust. In breaking granites, we find in their interior small es, brown and dull on the outside, but brilliant and of a very pale yellow within, and whose nents are attracted by the magnet. It is the decomposition of these pyrites, that the ies arise. My guides found fragments of granites, wherein were cubical pyrites from to four lines in thickness, whose fracture y brilliant, and of a very lively brassy yel- these do not decompose in the air.

We also find in these rocks quartz, with and nests of delphinite, or green schorl of hiny (actinote); it is but confusedly crys- d, but easily known by its puffing up un- he blow-pipe, and by the black and refrac- scoria into which it is changed.

In some parts these granites degenerate into larly schistose rocks, composed of quartz elspar, without any mixture of mica, and s layers are separated and covered with rgillaceous, nut-brown, ferruginous earth, h melts into a black glass.

These same rocks of granite contain a vein nitel almost entirely composed of laminar and brilliant hornblende, and of grey ucent felspar, which assumes outwardly a colour.

"In short, my guides found in
same rocks a *palaïopetre,* or primitive
of a grey approaching a little to gre
lucent at the thickness of a line, and
1, 2, scaly in its fracture, hard, inte
ternally with dots of a deep green,
scarcely visible but with a magnifying
which appear to be steatite; and also
dots of pyrites, which, in decom
a rusty colour the vicinity of the p
occupy. This stone melts under the
into a white and bubbly glass, like
felspar."

Our intelligent author thus descril
he observed on the summit itself of
brated mountain:

1990. "These rocks, situated
fathoms above the sea, are inter
being the most elevated of our glo
been observed by naturalists. M.
de la Condamine ascended the A
to an equal height, and even sor
higher than that of these rocks (2470
they were not however acquainted
but as they are said to have sent
chests full of specimens of the r
which their trigonometric operations
ducted them, I could have much

se specimens were examined by connoisseurs.
e late duke of Rochefoucault, a man equally
tinguished by his knowledge as by his virtues,
l who fell the innocent victim of the troubles
a country for which he had made, and would
e yet made, the greatest sacrifices, was very
ling, at my entreaty, to make the most careful
earches after these specimens, either at the
ng's garden, or at the Academy of Sciences,
which he was a member; but he was neither
e to discover them, nor any trace of what had
ome of them.

" The scarcity of specimens of rocks situated
similar heights, and the inferences we might
w from their nature in different systems of
ology, induces me to give a detailed descrip-
n of these.

" They are like those of § 1987, granites in
ss, where hornblende and steatite hold the
ce of mica, which is there extremely thinly
ttered; the sun and a magnifying glass are
cessary to enable us to perceive some white
d brilliant spangles; it is even doubtful if
ese brilliant particles, which it is impossible to
tach, are really mica.

" Felspar forms the dominant part of these
anites; constituting about three fourths of
eir mass. Their crystals, nearly parallelopi-

peds, vary as to size; there are an inch long, by six l br . T a dull white, slightly t t, l of the kind I have called ; pipe they yield a trans t bubbles, from which may 0,81, and consequently fusible gree of Wedgewood. Upon t r the bubbles dissipate, and the parent milky glass, which trating or dissolving. These cr appear here and there greenish account of a slight coat of earthy covers them.

"The quartz, which forms the fourth of the mass, is of a g r to violet colour; its fracture is une in some places, not scaly, but he rather conchoidal, a little flat. I nearly the same as that of the quar nites of § 1987.

"The hornblende, which forms too small a portion to be estimated, approaching to green; it shows s to the laminar and brilliant form; often merely glimmering, and ost fusible into a brilliant black glass, its interior; and which on the rod to the bottle green, through the brown; ards loses its colour, and dissolves with ffervescence, which proves there is a mix- magnesian earth.

ie earthy steatite, which also forms a very derable part of the mass of these granites, les that of § 1987.

l these granites have their natural divi- covered with some coat, either green or sh. This is an earth like chlorite, of a almost black, and a little shining on its l surface, but of a more bright green and in its fracture; soft, scratching with a h grey streak; at first turning brown un- blow-pipe, then yielding a knob = 0,3, ble at the 189th degree of Wedgewood. knob has a metallic aspect, somewhat un- and a little dull, like that of bars of melted and not only the knob, but all the parts te action of the flame renders brown, are ly attractable by the magnet. A small ent tried upon the rod of sappare, at first tes like ink between its fibres, then be- of a dull brown, and at length entirely urs, but without any appearance of dis- n.

ie green coat which covers other pieces e granites in their spontaneous divisions, is less dark, pretty shining, transluce and even a little unctuous to the t easily scratched to grey, changii blow-pipe into a translucent comes transparent on the rod of dissolves, but without effervescence. T appears to be of the nature of steat have not been able to obtain p ficiently large to measure its degree

The rocks of the southern parts this mit he thus describes, § 1993:

" 1. Granites perfectly similar to mentioned, § 1987.

" 2. Syenites or granitels, tl posed of laminæ of black hornb felspar, also laminar, but both in parts, that we may as well give t *trap* to these rocks, according to t I have given in § 1945.

" 3. A primitive petrosilex, or a pearl grey, translucent to two thirds with a scaly fracture in large and sufficiently hard to yield bright sparks, ing a grey streak when scratched by pointed steel. Under the blow-pipe form globules of 0,45; which indica fusibility of pig-iron, 126 or 130 of wood. It is a grey glass, semi-t

which on the rod of sappare gains in
rence and sinks, but without penetrating
olving, and even without entirely losing
bles.

is palaïopetre contains veins of from one
lines in breadth, which cross at different
and small nests of a deep leek-green horn-
confusedly crystallised, or in plates rarely
t, or in middling large fibres."

STRUCTURE I. OF A LARGE GRAIN.

ct 1. *Felspar, quartz, and siderite, often
ith mica.*

granite of Egypt, from the quarries visited
ny travellers beyond Syene, whence it is
Syenites, by Pliny, who specially mentions Syenites.
e obelisks are composed of it; while it is
sally admitted that they are a mere and ge-
granite, often containing no siderite *.

---

h Agricola and Aldrovandi mention syenite: the latter
ulgus appellat hoc genus marmoris granitum rubrum *cum
iceretur* pyrrhopoikilon; the latter word being also used by
denote the fiery red variegation of the felspar.

elebrated Zoega also informs us positively that all the obe-
of the ancient Syenite, that is, as he adds, our red granite.
n enimvero omnes obelisci in Europæ civitatibus obvii,
pias unum Florentinum (*e granite fusco*), et maxima qub-
eorum qui in Ægypto exstant, atque in Abyssinia; facti

The learned M. de Sacy, in his
lation of Abd-allatif, or Abdollatiph*,
A. D. 1210, wrote a c
uses the words *elle est gr*
rouge, tiquetée, qui est d'une

It appears from the same
the pyramids were covered with
with hieroglyphics; which the
might fill a book of ten thousand
bert, in his description of the pyr
the fragments of that covering,
coloured felspar, a little quartz, a
like that of Elephantina, near
ing existed till at least the thirt
Curious authorities concerning the
called Pompey's, particularly t

---

sunt e *Syenite* lapide, quem et *pyrrhopœcilum* v
autem *granito rosso*, lithologi *graniten rubrum*." Z
Romæ 1797, folio, p. 140.

Petrini, on breaking some pieces, found that
hornblende, it was always mixed with mica; as it is
black spots. Ibid.

Granite seems first to be mentioned by a
ages, Vacca, whose description of R is
faucon in his *Diarium Italicum*. V,
mor granitum Æthaliæ insulæ, that is,
isle of Elba," whence he supposed it
probably as ancient as the rest of
thirteenth century.

* Paris, 1810, 4to. p. 182.

. D. 400, may be found in the same work. It elonged to the *Serapeum*, which was a noble brary, much reduced by Diocletian, when he rdered the Egyptian works of alchemy to the ames*.

The same, with large patches of siderite, in the hinxes of the museum at Paris.

The same, running in veins through grey graite.

Grey granite of Egypt, consisting of felspar, uartz, and siderite: the *psaronion* of the ancients, om its resembling the colours of a starling.

Black and white granite, consisting chiefly of iderite with quartz, and a little felspar.

Dull green granite, of green siderite, with a ittle quartz and felspar.

Yellowish granite, of granular quartz, yellowish felspar, and greenish siderite, in large plates with etallic lustre, from Zillerthal.

Red granite, of felspar, quartz, and hornblende, rom Peterhoff in Russia.

The same, from Mount Sorel in Leicestershire.

---

* Oros. vi. 15. Some theoretic French writers had inferred that he Egyptians were negroes (in opposition to the mummies themelves), because they thought the Sphinx has negro features. Abdlatif, p. 179, tells us it was originally painted *red*, and the colour as still fresh in his time; nay Grobert, p. 32, observed a yellowish nge in parts not rubbed.

It also appears in masses on the road to
don.

It is also found in Greece, Norway,
the Hartz, Suabia, Stiria, Scotland, and other countries.

Aspect 2. Felspar, quartz, and mica.
granite of Egypt, without siderite, which,
justly observes, constituting all the obelisks,
real *Syenites* of Pliny. The mica is som
greenish black, sometimes tombac brown,
times grey, sometimes black.

The same, variegated with grey felspar.

Grey granite, *psaronion*, of the same
sition, from the same country.

Green granite. Of this I have only
specimen, found by Roziere in the r
bos, in Upper Egypt. It is the most b
all the granites, the felspar being of
emerald green, the mica silvery, and
transparent white*.

Blue granite, of white quartz, silvery
felsite of a sky blue, from Krieglach,
This granite, which is found in large m
highway, only yields in beauty to the

---

* Besson, in his memoir on the granite of Corsica (J.
mentions a granite of greyish quartz, and beautiful
green felspar.

Born says, that even the quartz is some-
inged with blue; which may be the Prus-
iron.

granite, with large mica, approaching to
om Portsoy, Scotland.

same, with crystals of schorl, from the
ace.

granite, joined with Tirey marble, from
of Tirey.

-coloured granite, from the Lago Mag-

n, or Isabella colour, from the Vosges
ns, France.

he green of the Vosges, see Talcous rocks.

granite, from the Alps, which are chiefly
ed of this substance.

lish granite, from the Carpathian moun-
Born, i. 377.

granite, in which the felspar assumes a
r oval form. This granite, found not far
tersburg, forms the basis of the statue of
e Great. Patrin, i. 95*.

yellow granite, from Greenland.

ite, with pearl-coloured felspar, from

ite, with red felspar, and very long-grained

Felspaths de Baveno, 1779, 8vo. p. 41) mentions oval
elspar, like a cylinder on an oval base.

mica, which passes into siderite,
brated quarry near Petersburg.
Mus. 374.

Granite, with milk-white felspar,
red, from the same place. Ib.

Granite, with tombac brown mica,
hemia.

Granite, with Labrador felspar, fr

White granite, of which the Escu
from Spain.

Violet granite, containing large cr
let-coloured felspar, from the Isle

Grey granite, from the Hartz.

White granite, from the Ceve

Dark blue granite, from Brazil.

Black granite, with black felspar, f

Grey granite, from Cornwall,
the country. It is white, with
mica, large-grained, and takes a
Costa, whose book appeared 1757,
that it abounds with that *kind of*
called *felspar* by the Germans.
the science the names of discri
few; and they will increase in
advances*.

---

* In his *Observations Mineral ques sur*
1782, 8vo. Sivry informs us, p. 93,
magny, there occur varieties of

The granites near the Hermitage, in Dau- iny, which yields the famous wine so called, ten present specks of a greenish black mica in ie very heart of the crystals of quartz; being alpably the same mica which is interspersed rough the granite. Sauss. § 1621.

A granite, which Saussure says is of a new rmation, crystallised in the crevices of mica ite, mostly composed of felspar, partly also with artz and mica. § 1267.

A granite, of which the quartz is of a lavender ue, the felspar of a yellowish white, and the ica, which is rare, of a dull leaden colour. 2144.

Granites with round crystals of felspar, like at of Finland. § 1195.

STRUCTURE II. OF A SMALL GRAIN.

White granite, with black siderite, from Mount nai. On this, according to tradition, the Laws Moses were engraved.

Red granite of Egypt, passing in a vein through rey granite, with patches of siderite, brought by oziere from the quarries of Syene.

ich, from the sharpness of their angles, and other symptoms, m even to have crystallised apart. These are, rose-colour with en spots, black with white spots, green and white, grey with red ts, brown with green veins.

Grey granite, of quartz felspar and siderite, from Egypt. Wad.

Small or middling g l g ite, partly grey partly red, fr I pt. W

Grey granite, from the c y, with felspar partly grey tly red.

Most of the kinds e Structure may also fc smallest or very minute l,

Small grained white g ite, th the summit of Mont J

White quartz, brown or r black siderite, from the I Al d

The same, from the Isle of El

Grey granite, with garnets, fr

The same, from Norway and

Grey granite, from Alençon. Tl mon granite used at Paris.

Grey granite, with nodules of the Alps of Dauphiny.

Light grey granite, with red lines c garnets, from Namiest in Moravia.

Grey granite, with veins of basaltin, way.

Secondary granite, in thin layers, fr of Gribon, Isle of Mull.

STRUCTURE III. VEINED.

ussure has described this rock with such acy and precision, and has himself so distin- ed it from gneiss, that it is surprising it l since have been referred to the latter. In the veins of mica run parallel through the which regularly splits in their direction. In d granite the seams of mica are irregular, rminate abruptly in various directions, being y the solid rock.

issure discusses, § 1726, the differences be- gneiss and his veined granite. In the latter lements are interlaced among each other; in gneiss there are fine leaves of pure mica, alternate with leaves composed of quartz elspar.

mentions, § 1799, an extent of more than leagues and a half of veined granite in hori- l beds: and, § 1802, veined granite in double g, sometimes between other beds in right which proves, according to Saussure, that it effect of crystallisation. That veined in zig- of a very fine kind, the quartz being scarcely guishable, while the beautiful white veins r to be entirely composed of granular fel- resembling a small-grained marble. The mica is also in small spangles, some black, chiefly of a beautiful silver white.

STRUCTURE IV. MINGLED.

Some of this kind have already been i mentioned. Besides schorl and garnets, observed chalcedony in granite, for w Composite Rocks. Chlorite and acti uncommon in granite; and the talc passes into steatite. Even calcare been found in granite; and, when porcelain earth, for which see the Rocks. Not to mention the met gypsum, anthracite, gneiss, basalt, stances, also occur in granite.

Granite, in veins in schistus, Sauss from Valorsine. He describes it as pas his roche de corne, which is generally basalt; the granite is of grey quartz, spar, and grey mica, and is regarded formed by infiltration.

Granite, in veins in primitive slate, land.

Granite, with veins of granular q Forez, France.

This account of one of the most im interesting rocks, shall be terminated by as concerning the manner in which it was sculp- ed by the ancients, as they may perhaps afford ful hints to the modern artist*.

Ancient sculpture.

“ Some further observations occur concerning Barberini obelisk, in the engraving of which ne instruments seem to have been used, of ich there is no vestige in the large obelisks; the straight lines, or those which form segments circles, are neither sharply cut, nor have they equal depth; but the concave bottom is deeper the middle part, and fainter at each end, till lines gradually vanish. Nor do they terminate cisely in the point assumed by the sculptor; the slender portion extends beyond the limits he figure.

“ Hence it is clear that the furrows were not de with a graver, nor with emery, rubbed as ual with a blade in the form of a knife, but h a kind of semicircular saw, to which emery s subjected, and by alternate motions of that trument. But in the right lines only; for where y are curved the saw must also have been of t shape. When however the figures, which in the cavities, are more turgid, and each part figured with some globosity, it is probable that y were formed with a little auger or trepan, or a kind of tube or hollow borer, by the assistance of emery, although no vestige of such an instrument appear, the surface of the figures having been polished by friction. It was natural that the artists should study to save time in this kind of work, and effect by saws, *tuctri*, and friction, what appears to have been accomplished in the great obelisk by the chisel or graving tool, or emery rubbed with a blade.

---

* For the original, see Appendix.

"6. Our artists, when they wish to cut any figure on granite, in the first place make a model of a thin plate of iron, which being fastened to the plane stone, they take another plate like a short knife, and use it to cut a furrow, by the help of emery, around the model first mentioned. The furrow being thus impressed to a certain depth, they take off the model, and begin to attack the intermediate space with a sharp graver or chisel called *subbia*. They then begin to form the figure, with a little sharp hammer called *pungetto*; and afterwards soften it with a broader hammer called *martellino*. This done, they polish it with lead and emery; and afterwards add the smaller lineaments, partly with a fine chisel, partly with the blade in the form of a knife and emery. Lastly, they polish the whole with the finest emery, called *spoltriglia*.

"7. Del Rosso thought he discovered marks auger in the obelisk of Heliopolis; and s, that without this instrument characters not be cut in a granitic rock. But he seems cuss a subject which he had not studied; for could be no use for the common auger, also a trepan, in this stone, which is harder than But the other auger, which is a brass tube ed to act on emery, though a convenient nent, is yet unnecessary, and is only used artists in forming deep furrows."*

MODE VI. GRANITIN.

Description.

en granite is composed of extremely mi- articles, it is not easily distinguished from , or rather from basalton, the grunstein of er. But where particles of siderite, or f basalt, which is an earthy siderite, are d with particles both of quartz and felspar, bstance is a granitin. When siderite is with felspar alone, it is basalton, or the stone of Werner; the real basalt, or iron- of the ancients, seeming properly to admit nixture, except spangles of siderite.

ral ancient monuments, supposed to be

---

* Zoega de Obeliscis, p. 189, seq.

green basalt, are really of granitin wi
of siderite, as mica is never so ı ıch (
Granitin also often forms
large or small grained granite,
country where that substance
substance being rather of micr
Green basalt. tion, the specimens are not c
basalt, properly so called, sho
neous, or present ly
may contain occasi ly very
of quartz only. The Isis of t C
231, is of granitin.

MODE VII. GRANI

When the crystals, especially
are extremely large, that is, fr
inches or more in length, the
well be called a graniton. It is c
Alps, and other granitic moun
ples may be seen in the foot p
minster bridge*. Graniton pr
mon colours of granite, that is,
red.

---

* Mr. Smeaton says it came from Llanlivery, near
Cornwall.

may also be denominated, from the
ing the size of plates of talc.
gregates, often confounded with gra-
be found in the division of Composite

ODE VIII. GRANITEL.

ntains called primitive chiefly con- **Definitions.**
substances, blended in various mix-
ly, felspar, quartz, siderite, and mica.
ree of these substances the appel-
ranite become vague and improper;
casioned great confusion in orology,
ription of mountains. Where only
the greatest of all geologists, Saus-
sed the name *granitel*; and his ap-
when not contradicted by necessary
arising from recent discovery, ought
be received with singular respect.
ranitel is also confirmed and appro-
the circumstance, that as the word
now consecrated by universal and
sage, being derived from the Italian
presenting the appearance of grains
; so a modification of granite ought,

ridiculously said, that it is derived from the *ge-*
; which would only imply a stone shaped like a

in due analogy, to receive its name fr
same language.

Granitel sometimes consists of as mi
ticles as granitin, so as to assume the ap
of a coarse basalt. From this con
Wad observes, some of the Italians
same substance *granitello verde di Egit*
others call *basalte verde.* He describes
cimens*: "1. Granite with very minu
consisting of greyish white felspar,
of a dark green, in equal portions. G
of a very small grain, composed of g
felspar, and greyish black siderite,
larger portion of olive-green sideri
ders the rock green."

Mica of no account.

Mr. Kirwan has justly observed, t
ple addition of mica to any stone,
entitle it to be placed in the grani d
mica does not form a grain, but
indifferently to many sorts of ston
are micaceous limestones, micaceous
micaceous serpentines, &c. &c.
therefore be totally excluded from the
and felspar with mica, or quartz with

---

crane's bill, *geranium!* But Pliny says himself, xxxvii. 11,
collo geranites. See Laet, p. 170, for a print of a
the first appearance of the word *granito*, see a former

[*] Fossil Ægyp. p. 7.

y be properly classed with the simple rocks
elspar or of quartz. There are therefore only
ee genuine structures of granitel; namely,
Felspar with siderite. 2. Felspar and quartz.
Quartz with siderite.

UCTURE I. WERNERITE, FELSPAR WITH SIDERITE.

Wernerite.

The appellation has been derived from this
ebrated mineralogist, who well deserves to give
name to one of the most important substances
nature. It is also intended to compensate,
ile it calls to memory, his noted syenite, a term
ll chosen as to have introduced confusion, in-
ad of illustration. The syenite of Werner, as
eady mentioned, consists of felspar with side-
e, that is, the former is more abundant; but
basalton, or grunstein, the siderite predomi-
es, and gives a black or greenish colour; while
rnerite is generally reddish. Yet the syenite
Werner sometimes contains quartz and black
ca, which infallibly constitute a granite; and
stone should, in that case, be said to pass into
nite. The appellation of Wernerite is here
ctly confined to a mere and sole admixture of
par with a smaller portion of siderite; and as
ours form the meanest of all distinctions, no
sideration is paid to that circumstance.

Wernerite of white felspar and black [illegible] from Mount Sinai. It sometimes passes [illegible] granite; and is reported by tradition to be [illegible] stone on which the commandments were [illegible] graven.

Of red felspar and black siderite, from [illegible] Alps. It is sometimes mixed with mica, or [illegible] and if quartz were present, it would then [illegible] tute a granite.

Of grey felspar and black siderite, from the ejections of Vesuvius. These substances [illegible] or distinct, may be said to form all the [illegible] [illegible] is sometimes mixed with garnets or [illegible].

Wernerite of grey felspar with [illegible] blende, forming a vein in granite, on the [illegible] of Mont Blanc. Saussure, § 1987.

Wernerite, from Muhr in Stiria.

Wernerite, in rolled pebbles, from the Lake of Geneva.

Of brownish red felspar and black [illegible], from Leipzig.

Of reddish white felspar and black [illegible] from the Hartz.

STRUCTURE II. LEHMANITE, FELSPAR WITH [illegible]

Lehmanite. This name is given to a primitive [illegible] from the celebrated Lehman, who first [illegible]

e distinction between primitive and second-
ountains.
nmanite of felspar and quartz, from Corn-
e same of white quartz and red felspar, from
nd.
s common in the Alps, and other chains of
tains.
umanite of a reddish white, from Sweden*.
hmanite, from Grimsel. It is also found in
au and Siberia, and near Portsoy, in Scot-
Linnæus, by Gmelin, 214.
a yellowish white, from Finland.
Costa says, p. 278, that part of Newry,
d, is built of this stone, there called *mountain*
Another part is of felspar and large green

TURE III. HENKELITE, QUARTZ WITH SIDERITE.

Henkelite.

e name is derived from Henkel, who may be
d among the fathers of lithology. The al-
es between quartz and siderite seem to be
r uncommon, felspar having been commonly
ken for the former substance.
nkelite, from Switzerland.

---

* Wall. i. 422.

In Switzerland it often contains

The same, from Altenberg, in Sa

The basaltic granite of W ,
mania. It is either black, y

The same, of an iron c fr
Sweden; but this seems rather to
siderous division.

Henkelite is also found in
Tyrol, Stiria, &c. It is believ
black and green granites, so
of this substance†.

STRUCTURE IV. MINGLI

The most usual parasitic sto
schorl and garnets, both compos
of iron.

Wernerite, with garnets, from Vesuvius.

The same, with actinote, from t

Lehmanite, with steatite, from t

Henkelite, with garnets, from the

The same, with steatite, from t

The same, with schorl, from t

---

* Linn. 218.

† Launay, Essai sur l'histoire
1786, 12mo. p. 41.

MODE IX. GRANITOID.

any rocks, inaccurately classed among gra-
are reserved for the Composite Domain.
alone as perfectly resemble granite, but
f a very different modification, are here
l granitoids; and this denomination pre-
three different structures.

STRUCTURE I. CALCAREOUS GRANITE.

this rock lime-stone supplies the place of fel-
This substance was first mentioned by
, as forming chains of mountains in Canada.
s afterwards described by Saussure. Wer-
ıld me that he regarded it as a truly primi-
ime-stone.

lcareous granite, from the mountains of Ca-

e same, from the vicinity of Mount Cenis.
n the Alps it more commonly assumes the
of gneiss, as at Roth Horn, Mont Cervin, &c.
ddish calcareous granite, or primitive lime-
with quartz and mica, from Scotland*.

---

e Journ. de Ph. 1791, mentions a calcareous granitoid, the
ne or spar being in globules of an oval form, with crystallised
and compressed horizontally.

STRUCTURE II. ARGILLACEOUS.

This rock is more often the pr uct position, which changes the fel i

Argillaceous granite, with q martial clay, from Hungary and Swe

STRUCTURE III. TALCOUS.

From this division talc, and even be excluded, as being often mere decompositions of mica.

Granitoid of felspar, quartz, from Transylvania.

MODE X. GRANITIC POR

Description. In this substance, which is very nature, some large or distinct cr are sprinkled on a base of base being here assumed as t classification of the substances porphyries, it must of course sion. The base may c st of and siderite; or quartz, f , even any two of these ries of Saussure, § 150, belong to this but granitic porphyroids are so abundant primitive mountains, that it is scarcely ry to select examples, being a mere vain the construction of granite or granitin.

itic porphyroid, from Mount Cenis.

same, from Cornwall, Wales, Scotland, sges mountains in France, the Alps,

ure, § 155, gives some curious observa- the transitions from granite to granitic ry. A great portion of Forez is of por- while the adjacent portion of Auvergne tic.

MODE XI. GNEISS.

Distinctions.

n the materials of granite are disposed in ers, or plates, the substance assumes the f Gneiss; which consequently consists of felspar, and mica. In his two first vo- published before Werner had introduced precision into the science, Saussure has nes used the term veined granite, to ex- hat is now denominated gneiss. But in er volumes, as already explained, his granite differs from gneiss, as presenting

only short and irregular veins,
solid masses; while in gneiss the v
form, and regularly divide the wl
or in other substances properly
gneiss has also been called scl
the French, and other writers.

In gneiss the mica is generally
ant, as dividing the substance into r
Sometimes the place of mica is
siderite, which, as already exp
to granite, cannot be regarded
denomination, but is only a proof of
tiquity. The siderite is also
spersed in thick layers, or even
the most interesting kinds of gne
Red. red felspar, sometimes of a wavy
structure, and which is also c
as the most ancien . This, like
Contorted. substances, is found contorted, or
fantastic forms; by some regarded
from internal expansion or dis
others consider it as the mere
cular crystallisation.

Primary. Geologists in general have c
as the oldest substance, the fi
which supports all the others: t
however regarding it, on the cont
newest substance, which, being ele

n, has broken the other stratifications.
ver this be, it is certain that gneiss has, in
and example of the Alps, been found un-
ranite confessedly primitive; and they are
found alternating with each other. The
mountain of Rosa, which only yields in
to Mont Blanc, instead of being com-
of arrects or uprights*, that is vertical
, or plates like the latter, presents, on
ntrary, horizontal beds of veined granite,
, and other schistose substances†.
rmixed with gneiss are sometimes three
pal rocks, all regarded as primitive; lime-
siderite either solid or schistose, and por-
. But these substances equally appear
ixed with granite, only alternating verti-
; while in gneiss they present horizontal

In the old Egyptian monuments nothing
re common than to find large masses of
e intermixed with the granite; and even
in often penetrates that substance. The
tian monuments of mica slate, described
ad, may perhaps more properly belong to
.

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a new science new words must be admitted. Saussure,
rs, have long lamented the absurdity of *vertical beds or*
Arrects or uprights would supply the deficiency.
s. 2138.

Primitive lime-stone likewise altern granite, and has even been found to granitic forms. The alternation of p with granite is of general observation mitive mountains.

Fertile in metals.

Gneiss also frequently contains g note, magnetic iron, and pyrites. It clay-slate, the most metalliferous of The chief mines of Saxony, B(em burg, are situate in this rock, very common on the Continent, is com rare in Great Britain and Ireland.

STRUCTURE I. TABULAR, OR IN THICK FORMS.

This kind is commonly derived from granite, or passes into that rock.

Tabular gneiss, from the Alps.

The same, from the isle of Leuis, rior chain of the Hebudes, Scotland.

STRUCTURE II. LAMINAR.

This is the common appearance of may be divided into two Aspects.

Aspect 1. Plane or level. Gneiss, with felspar, from the Alps, Norway, Saxony.

neiss, with white felspar, from the same coun-, Salzburg, Greece, &c. It is a common, and as a fundamental rock in the Brasils. Mr. eson says, that it is found in the isles of Coll, y, and Rona; also in the Shetland isles, and y parts of the main land of Scotland.

spect 2. Undulated. This is more uncommon the former.

ndulated red gneiss, from the Alps of Dau-y.

he same, singularly contorted, from the same This forms a remarkable diversity.

ed gneiss, from Norway.

rey undulated gneiss, from the same countries.

STRUCTURE III. IRREGULAR.

this kind the layers intersect each other irre-rly, in the form of wedges, &c. It differs the veined granite of Saussure, because the ions do not terminate in massy portions, but continued in oblique and irregular directions.

ed irregular gneiss, from the Alps, Norway,

rey, from Brasil, and other countries.

Interesting examples of this kind r
mines of Salzburg, and particularly
Macugnaga, near Mount Rosa, in t
Italy. This rock has always been
but is composed of thickish plates of q
thin seams of foliated mica, or
Gneiss also occurs composed only of
mica. As the first of these kinds h
observed in Italy, I would pr
Pinite and Ferberite.
Pinite, from Pini, an illustrious
explored the southern Alps. T
called Ferberite, an honour due to F
travels illustrate many parts of I y,
south of Germany.

Aspect 1. Pinite of quartz and steatite, from
Macugnaga, near Mount Rosa,
The same, from Salzburg.

Aspect 2. Ferberite, from the Al
Gneiss also occurs of quartz and
of felspar and siderite.

STRUCTURE V. MINGLED.

ey gneiss, with garnets, from Bohemia.

e same, with actinote, from the same.

e same, with pyrites, from Bohemia.

e same, with different metals, from various ries.

ite, with gold pyrites and native gold, from gnaga.

e same, with native gold, from Salzburg.

e following examples of various kinds may ded, from Saussure :

emarkable gneiss, of a bluish grey mica, in- g long grains of quartz and felspar, which r like sand, but are in fact crystals more or egular. § 1221.

gneiss, composed of irregular layers of white lar quartz, and leaves of a substance inter- te between slate and steatite. § 2044.

fine gneiss, composed of black mica, ap- hing in splendour to graphite, intermixed particles of felspar, and sprinkled with small ets. § 1732.

gneiss, composed of grey felsite and grey § 1877.

gneiss of foliaceous mica, with plates of tz, sometimes mixed with felspar, forms the mountain which contains the copper mi George. § 1201.

Werner has a large piece of mas e inclosing rolled pebbles of gneiss. § 21 sure gives, § 661, examples of g in mica slate, or rather gneiss.

In the mountains on the south of Chamouni, the inferior parts are g the summits are granite. § 677.

Mount Rosa is wholly composed of nite, gneiss, and schistose rocks, from t the highest summits. § 2138.

MODE XII. PITCH-STONE.

Characters. Texture, impalpably fine, r

Hardness, basaltic, sometim ture, conchoidal; if impure, splin grained. Fragments, irr

Weight, carbonose.

Lustre, from glistening to s Somewhat translucent; but t the edges.

The colours are various shades of sometimes grey, brown, red, s the tints are commonly pale.

Sites. Pitch-stone forms entire

id in other mountains of that country it
arge strata, that alternate with porphyry*;
they contain abundance of quartz and
may be called pitchstone-porphyry, for
see the Siliceous Intrites.

n-stone is universally regarded as a pri-
rock; but it is also often found second-
d constituting the substance of petrified
In the island of Arran it forms large
n sand-stone; and it also occurs in Mull
g. This curious and important substance
unknown to Wallerius; but Gmelin, in
ion of Linnæus, has called it *opalus piceus*,
ntioned many of its sites, as Iceland, the
Elba, Auvergne, Transylvania, Hungary,
sgeberg mountains in Germany, and New
It sometimes occurs in basalt.

STRUCTURE I. COMPACT.

h-stone, from Meissen in Saxony, where it
rst observed.

same, dark red, from Korbetz in Saxony.

same, spotted with black, from Upper
ry.

same, deep red, mingled with greenish

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* Kirwan Geol. Ess. 180.

transparent opal, from Upper Hungary. Born i. 213.

The same, of a clear blue, from Telkobanya in Upper Hungary.

Green, from Meissen in Saxony.

Green pitch-stone, with adherent sand-stone, from Arran.

The stalactitic kinds, and the petrified wood from Hungary, cannot be said to constitute rocks.

STRUCTURE II. LAMINAR.

Laminar pitch-stone, in thin hor
alternately white and violet, from Telk

A laminar kind was also discovered
Jameson in the island of Arran.

MODE XIII. SILICEOUS INTRITE.

German porphyries.

These rocks present crystals of felspar, sometimes quartz, or calcareous spar, in a siliceous ground or base. The most remarkable kinds are those called keralite or hornstein porphyry, and pitch-stone porphyry. They are vaguely classed under the general name porphyry by the German theorists, while the crystals are so unimportant, that in geology they should be

ed immediately after the parent rock. The
itive porphyries, according to Werner, are
of hornstein and felsite; to which may be
d granitic porphyroid, already described
granite. If a jasper porphyry be found, it
also be admitted. The classical porphyries
naccountably treated with great disregard,
g considered as primitive grunsteins; and
real red porphyry seems as unaccountably
tted. Secondary porphyry includes those
bases of pitch-stone and of clay. The Ger-
s have never been celebrated for clear ideas;
it is truly painful to observe such an utter
usion of important substances in elaborate
ms, while the most trifling objects are elu-
ted with infinite patience and assiduity.

Turpe est difficiles habere nugas,
Stultus et labor ineptiarum.

STRUCTURE I. KERALITE PORPHYRY.

he keralite is generally reddish or greenish.
sometimes said to form mountains in Siberia
other countries.

STRUCTURE II. FELSITE PORPHYRY.

Saussure mentions a porphyry with earthy felspar. What is call kli phyry, or porphyry slate, by W common and at the same time t r able substance in this division. It ready described under the Mode Fel

STRUCTURE III. PITCH-STONE

This has been chiefly observed in where the base is generally a dark or pitch-stone, with lighter crystals of also occurs in the island of Arran.

In those parts of Auvergne w h volcanic (a position to which the r ciples of Werner, who have visited such as Buch and Daubuisson, have been converted), pitch-st decomposed, and partly reduced to mass, resembling ochre of iron, arising from the five parts of ir tains. This substance will be more scribed in the division of Decomposed R

MODE XIV. SILICEOUS GLUTENITE.

Description. This division will comprehend many important substances of various structures, from the celebrated Egyptian bricia, containing large pebbles of jasper, granite, and porphyry, to the siliceous sand-stone of Stonehenge. Origin. The glutenites are of various formations; and the pudding-stone of England would rather seem, as already mentioned, to be an original rock, the pebbles or rather kernels having no appearance of having been rolled in water. Patrin[*] has expressed the same idea concerning those pudding-stones which so much embarrassed Saussure, as he found their beds in a vertical position, while he argues that they could only have been formed on a horizontal level. Pudding-stones and bricias. This curious question might, as would seem, be easily decided by examining if the kernels have been rolled, or if, on the contrary, they retain their uniform concentric tints, observable in the pudding-stone of England, and well represented in the specimen which Patrin has engraved. But the same idea had arisen to me before I had seen Patrin's

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[*] i. 154.

ingenious system of mineralogy. In like
ner rocks now universally admitted to c
granular quartz, or that substan cr
in the form of sand, were formerly
consist of sand agglutinated. Sev
rocks contain glands of the same
that great observer, Saussure, has
Glandulites, an useful denominati ,
glands are of the same substance wi
while Amygdalites are those rocks
tain kernels of quite a different
observes, that in such a rock a
crystallisation may attract the
matter into a round or oval form,
fined and distinct; while other par
stance, having no point of attrac
alesce into a mass. The agency of
also be suspected, that metal,
its ores, often occurring in detac l
oval forms of many sizes, and even
portion having a great power*.

On the other hand, many kinds of
stone consist merely of rounded pel
sure describes the Rigiberg, near
Lucerne, a mountain not less than

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* Buffon had on his estate a large and impo
the iron ore was solely in the form of peas.

t above the sea, and said to be eight leagues
cumference, which consists entirely of roll-
bbles, and among them some of pudding-
, probably original, disposed in regular
, and imbedded in a calcareous cement.
udding rocks around the great lake Baikal,
: centre of Asia, present the same phe-
non; but it has not been observed whether
ragments be of an original or derivative
The derivative are supposed by theorists
ve proceeded from vast currents, flowing
the primitive mountains, as on the dimi-
n of the primitive waters these mountains
ppeared in the shape of islands, while the
ning parts of continents required many
before they emerged from the ocean. It is
rkable that this corresponds with the most
nt ideas; for the Argonauts are represented
iling from the Euxine Sea to the British
n; and Cesar describes Britain as an island
d between land and water, the rivers being,
most countries newly inhabited, of enor-
s size.

Sand-stones.

ne siliceous sand-stones form another im-
int division of this mode. They may some-
, as already mentioned, be confounded with
ılar quartz, which must be regarded as a
ary crystallisation. The sand, which has

also been found in micaceous schistus, vast depth in many mines, may be well re as belonging to this formation; for it known, that if the crystallisation turbed, the substance will descend gular particles.

Siliceous sand-stones are far more than the calcareous or argillaceo of the chalk country in Eng marked by large masses of siliceous irregularly dispersed. Those of ford remarkable examples of the s of those fragments, but the original r been discovered. Trap or basaltin on siliceous sand-stone.

STRUCTURE I. LARGELY GRANULATED.

This division of course includes silice and pudding-stones. The most emi gular of these occur in Egypt, in t universal bricia of the Valley of C the siliceous bricia of the same chain, are imbedded those curious pebbles k name of Egyptian jasper; and which times contains agates. This last, from and decomposition, might perhaps be perly classed among the Siderous Intrites; Bricia of Egypt.

a proper analysis be formed, it may as well
low the universal bricia, to which it may be
garded as a remarkable rival. Bricias, with red
sper, also occur in France, Switzerland, and
her countries; but the cement is friable, and
ey seldom take a good polish. All these rocks
esent both round and angular fragments, which
ows that the division into bricias and pudding-
ones cannot be accepted: a better division, when
operly ascertained, would be into original and
rivative glutenites. In a geological point of
ew, the most remarkable pudding-stones, which
ight more classically be called Kollanites, from
e Greek[*], are those which border the chains of
imitive mountains, as already mentioned. The
nglish pudding-stone (for a particular account of **English pudding-stone.**
hich see the Anomalous Rocks) is unique; and
eautiful specimens are highly valued in France,
nd other countries. It is certainly an original
ck, arising from a peculiar crystallisation, being
mposed of round and oval kernels of a red, yel-
w, brown, or grey tint, in a base consisting of
rticles of the same, united by a siliceous cement.
coarser kind also occurs, consisting of grey
bbles in a far more abundant grey cement; it

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[*] Κολλα, cement; the more proper, as it also implies iron,
a the chief agent.

seems harder than the pebbles, t
are apt to drop out entire, the circum
crystallisation having been as exactly
the laws of attraction, as in the detac
little geods of iron, already men
supposes that they were formed
afterwards cemented by siliceous m
many other crystals are easily
gangart, there seems to be no
supposition.

Pebbles. Saussure, § 1943, has treated t
study of pebbles. In the glens of
they are of the same stones with t
but in the plains, and the large
they are of quite a different natu
have been transported by some gr

" It is an important observati f
of the earth, that in the upper
surrounded with high mountains,
are found, which are foreign to the
which they are met with; those o
other than spoils of the neighbouri
In the plains, on the contrary, and
of valleys which adjoin the p s,
way up the sides of the moun
on these plains, pebbles and blocks
which might be said to have fallen fr

vens, so different is their nature from every thing found in the environs."*

The same able observer describes, § 957, the triumphal arch of Augustus, at Aosta, as constructed of large squares of a singular kind of pudding-stone, or large sand-stone, being an assemblage of fragments, mostly angular, of all sorts of primitive rocks, quartzy, slaty, and micaceous, the largest about the size of a hazel nut. The cement he does not mention. Most of the ancient edifices of Aosta and its environs are of this stone, and the common people are persuaded that it is a composition, as was also the first general belief concerning granite; but Saussure observed the rocks in the mountains on the north, above the road to Yvree. **Triumphal arch.**

Aspect 1. Green universal bricia, from the old Egyptian monuments.

The celebrated sarcophage, in the British Museum, is of this stone. As it chiefly consists of green jasper, it may perhaps more properly belong to the Siderous Glutenites.

The same, from the Valley of Cosseir.

Aspect 2. The same, with rolled granite and angular fragments of porphyry, from the same.

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* Sauss. 717.

This is very rare, having been rejected by the ancient artists. There are also other diversities.

Aspect 3. Egyptian kollanite, or
stone, containing balls of brown jasper,
times agates, with angular or round cr
unctuous quartz, in a brown ferruginous
of an unctuous appearance, owing to
ance of that quartz which seems u
in forming the cement, from the valley of Suez.

Aspect 4. The same, without the ls
per or agate, a fragment of the c
of Memnon, in Upper Egypt.

Aspect 5. Jasper bricia, intermixed with
stones, from Forez, in France.

The same, from Switzerland.

Aspect 6. Quartz bricia, consis
ments of that substance joined by the ce-
ment, from Smoland, in Sweden.

STRUCTURE II. SMALL-GRAINED.

Sand-stones.

In the Mode of Glutenites it would be
as the celebrated Romé de Lisle has
remarked, to fix a precise boundary
ding-stones and large-grained sand-st

Even the Egyptian kollanite above mentioned ight, without the balls of jasper and agate, be nsidered as a large-grained sand-stone, singurly formed of unctuous quartz. The large-rained siliceous sand-stones are however far more ure than those of a finer construction. It is not usual to find in them, as in other sand-stones, odules or veins of green earth or chlorite, a subtance also common in sand; and, like its parent ron, more widely diffused than is commonly imagined.

Mr. Kirwan's account of siliceous sand-stone is too interesting to be omitted.

"This stone is generally reckoned among the secondary; yet where no organic remains are found in it, where it does not rest on any secondary stone, where no secondary stone enters in its composition, I do not see why it may not be aggregated to the primary. Sand, amongst the conulsions occasioned by the volcanic eruptions efore the creation of animals, must have been ormed; and even independently of these, some nust have been deposited, during or after the rystallisation of the various substances contained the elastic fluid. See 5th Sauss. 294. Mount rat and the Coteau de Boissy, near Geneva, Sauss. 246. 349, seem to be primeval; so also e sand-stone found in the island of Bornholm, 5 Berl. Beobacht. Also that mentioned Sauss. § 763, which graduat also be primary, though it contains lous roulés). The sand-stone near I the vicinity of Prague, graduat into and even into granite. Mr. to have been originally a g ite, was decomposed into clay, t the quartzy grains; a most in bable conjecture. 1 Bergbau, 3

"Most of the arenilitic moun of on both sides of the Elbe, appear to by Reuss's description. See Reuss, the east and north parts of them are split, or form colu salts. 2 Berg. Journ. 1792, 70.

"In Bohemia, sand-stones with cement alternate with those whose ceous. Reuss. In Kinneculla, t incumbent on granite seems also to over it the secondary strata repose. Abhand. C. 29. 5 Bergm. 126.

"In Brainsdorf, in Saxony, it tose mica, and alternates with a Beytr. 64. In Reigelsdorf it mental rock on which semiprotol lies, which is covered with other sec y 2 Berg. Jour. 1790, 285. Near Oy

'acts of Saxony, no petrifactions or conchy-
impressions are found in it, though in that
na, adjoining, they are found. Charp. 24
5: it sometimes reposes on horn-slate.
24.

e mountain Steinthal, in the Vosges, of red
one, is considered, by Baron Diedrech, as
l. 2 Diedr. *Gites des Minerais*, 209, 210.
nd-stone mentioned in 6 Sauss. 81, which
tes with primitive lime-stone, must also be
re."*

gniart, in his Mineralogy, has adopted
singular distribution of the *grès*, that is,
sand-stone, and arranges it immediately
uartz. He informs us, in a note, that he
re describes the pure and homogeneous
one, composed solely of quartz; the other
commonly called sand-stones, being placed
the rocks, where they will be described
the name of *psammites*. The stone which
nes is composed of very small grains of
"agglutinated by an invisible cement."
therefore the hardness and infusibility of
in its grains; but its texture changes the
of its fracture. This fracture, always gra-
ometimes scaly and even shining, without

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* Geol. Ess. 208.

ceasing to be granular, is sometimes level, s times conchoidal. When this grit is strikes fire with steel; when friable, its can only be judged by the ease with w scratches steel, and the hardest glass; it not scratch beryl. These characters distinguish it from dolomite, granular sul barytes, emery, and some horn-st, substances to which it bears some res

He then enumerates several varieties: 1. the *grès lustrè* of Haüy, which betrays its texture by its translucency. It forms Montmorency, near Paris, and arrects near bourg. The very ingenious Gillet disco under a violent blow of the hammer, pyramid or wide cone is often extricated. white sand-stone found to the south of I often used for grindstones; while that of I bleau, which is in very thick horiz serves to pave the streets of Paris. times mixed with lime, which makes it but this alteration is more rare than is c conceived, and is only observed in the called Belle Croix and Nemours, where found the curious crystals in which the q sand assumes the calcareous form. 3. Ri grit, so called because various colours are played in straight lines or in zigzag: it is com-on in Thuringia and in Magdeburg. 4. Red rit, which is of a coarse grain, and the particles nited by iron. This is the deadlayer of the Germans, which it is ridiculous to class here, as it totally differs from his introductory definition. 5. Flexible grit of Brazil. 6. Filtering-stone, full of numerous and irregular pores, but seemingly composed of quartz only. It is found in Saxony, Bohemia, New Spain, and the Canaries: it is also found in Spain, in Guipuscoa, where they make statues with hollow heads, so that water being poured it passes through the eyes, and the figures seem to weep.

Such, he says, are the principal varieties afforded by grit or sand-stone, considered as homogenous, and not as a mingled rock; and he adds some examples of sand-stones originally crystallised with that texture: but when he includes the red ferruginous sand-stone, he forgets that it sometimes contains fragments of porphyry and other rocks; and parts of the remainder of the article refer to argillaceous and even calcareous sandstone. This stone therefore, which he places between quartz and flint, ought to have been classed with the former under the usual denomination of granular quartz.

Mr. Jameson has observed*, that there is a

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* Geog. p. 39.

sand-stone cemented by quartz; so that a c
cal and mechanical formation may occur in
same rock. He mentions, in another work*,
there is a vein at Lauterberg, in the Hartz,
fathoms wide, filled with quartz in the
sand. Pepits of copper are intermix ,
miners only use picks. It is crys
the product of decomposition; if pe
siliceous juice, it would have been
Fine examples of siliceous sand-stone
found in Salisbury Craigs, near Edinburgh.

Aspect 1. Coarse siliceous sand-stone,
Sweden, &c.

Aspect 2. Fine, from Stonehenge, &c.

The same, from Salisbury Craigs, near Edinburgh.

Elastic siliceous sand-stone, sometimes called elastic quartz, from Brazil.

Siliceous sand-stone, like most other rocks, is also found schistose and laminated.

Add the following varieties, from Saussure:

A remarkable sand-stone, composed of
small grains of white quartz and felspar,
little specks of greenish mica, which abs

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* Dumfriesshire, from Voigt.

lity, becoming greenish and translucent, esemble a felsite or jad. § 1242.

d-stone of a violet colour, common be- ntibes and Frejus. It contains bits of , and fragments of other sand-stones.

us sand-stone, which resembles gneiss, nates with lime-stone and slate. § 763.

of a beautiful sand-stone, composed of grains of quartz. § 1370.

n sand-stone, of little fragments of quartz, nt of felsite. § 1539.

s not only the produce of crystallisation, even be produced artificially by an ope- that kind. § 1375.

l, a mountain between Sallenche and ll down, with such a thick and horrible used to the distance of five leagues, that ought the end of the world was arrived. ndermined by a lake; and vast masses of l down day and night with a noise like

Fallen mountain.

Among the ruins of this mountain Saus- d the following singular sand-stone:

ments of a kind of greenish sand-stone, y spotted, very hard, and of a very fine

---

icia of Rosenberg, which fell in 1806, somewhat re-

"This sand-stone effervesces with aquafortis very weakly; but the effervescence may be increased, if the acid in which it is put is heated; but which does not deprive it either of its coherence or its hardness, for it strikes fire, even after this proof. The grains of fine sand and mica, of which this sand-stone is composed, must then be united by a quartzy or argillaceous gluten, and the calcareous particles which produce the slight effervescence that was observed, be infiltrated, and deposed as a foreign body in its external pores.

"I have seen in Italy antique works, which were said to be basalt, but which appeared to me of a kind of rock very similar to this, and consequently very different from real volcanic basalts. A statue of a child, that is shown in the gallery of Florence under the name of Britannicus, and which is said to be of basalt, is most likely of this same kind of rock. I have had a piece of this sand-stone worked; and the kind of polish which it has taken, perfectly resembles that of this statue."*

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sembles the green bricia of Egypt, as I am informed by French traveller.

* Sauss. § 493.

G. Cooke fecit

Andes near Quito

DOMAIN III.

ARGILLACEOUS.

◆

ARGIL.

earth is obtained in the state of
t purity from alum, which is a mix-
argil and sulphuric acid. If it con-
yd of iron, as is frequently the case,
a particular smell, when breathed
well known by the name of an
smell.

With heat it loses its water, and diminishes in bulk; but a very violent h converts it into a white amel. When c bined with lime it easily enters into fu

Argil, also called Alumina by recent chemists, is of great utility, as f basis of many manufactures, suc porcelain, and earthenware. T 98 parts in the 100 of cor which division are now cla perfect of the precious stones, after the diamond, such as the sapphire, ruby, oriental topaz. It is hence not only one of the most noble, but one of the most useful of the earths; loam or fertile being a mixture of about 30 parts with 70 of fine sand; while mould cl consists of animal and vegetable remains.

In the primitive rocks argil portant feature, forming about of felspar, and a third of mica. T ancient slates abound in argil. It is so homogeneous that it cannot be re as the waste of former mountains, pure deposit of primeval waters. In itive schisti however there is still a t preponderance of sand; and the sy appearance may sometimes proceed decomposed mica.

he argillaceous rocks are mostly of a le and uniform appearance, and do admit the numerous modifications of other substances. This earth is chiefly ent in gemmology, where it constis some of the most beautiful varieties. argillaceous rocks are never crystal-, and present but small splendour in r appearance*; hence they are very om used in the ornamental arts, and chiefly important in a geological point iew, where they often rank among the t important primitive substances. Yet in this light they have not been ted with the attention and minute inigation which have been bestowed upon Siliceous and Calcareous Divisions.

he essential part of the argillaceous

---

rongniart, i. 512, informs us, that as the argils never crystalhey afford no *species*. A further proof that this term is foreign eralogy.

rocks being alum, it seems the most tural progress to begin with those stances which chiefly supply c with that earth.

MODE I. ALUM ROCK.

Of this there are two very different st the alum rock of Tolfa, which y called the Roman alum, and the c nous slate.

Alum of Rocca.

It has been said by some that the of the middle ages derived its name in Syria, called Roch or Roque, *Rocca*; pilgrim having observed the same ki near Civita Vecchia, the Pope fo lebrated manufactory which su for some time*. The description has been given by several mine under the class of salts; but it may ing to present the accurate account who mentions, that the rocks whi Roman alum constitute white, hi laceous hills, of a compact scarcely any visible horizontal beds; but there are some fissures filled with quartz, yielding what are called Tolfa diamonds*. He afterwards proceeds:

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* Wall. ii. p. 43. Alum is classed among the salts by writers, and is called sulphate of argil.

Tolfa.

"The alum hills are very high, shining, white rocks, separated by a long valley, and large excavations, which are made in the following manner. The workmen descend by ropes to the steep rocks; thus suspended, they bore blasting-holes, fill them with cartridges, free the rocks which by former blastings are loosened, and then are pulled up again. The firing of the powder is done by dry branches and leaves, which experience has taught them to throw from on high to any place below.

"The alum rock is whitish grey, or chalk-white; extremely compact, and remarkably hard. Scraped with a knife it yields an argillaceous powder, which does not ferment with any acid, as it is penetrated by the vitriolic acid, and composed of an argillaceous substance. There are some bluish grey shivery pieces, which are rejected as unfit, and probably are the remains of the natural argillaceous stone, before it was sufficiently imbibed and whitened by the vitriolic acid. In some cracks appears a chalk-

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* Italy, 206.

white ductile clay. Some p
grey, with white spots, produced by
They much resemble the half-d
lava in *Solfaterra*, with white,
schorls; with this difference, tl
the subterraneous acid worked u
here upon an argillaceous bluish
acid seems in this place likewise to
by subterraneous steams, which,
argillaceous stones, changed t
ore. I could not ascertain
near Tolfa ancient volcanoes; but I
fragments in the wall under tl
and therefore they cannot be far

" By all this it appears that
rock at Tolfa is an indurated clay,
bibed and been whitened by a vit
contains some few calcareous
in the alum manufactories, pre
wooden rills or troughs, under the
nites. It is a compact and sound r
stratified nor shivery and slaty.
perpendicular white-grey q tz
four inches wide, cross it fr t
and in some places appears in
white rock a red mixture, as it r
thar vitrioli, or *crocus martis*, or s
which resemble red and white marbled

e blasted stones are calcined in furnaces,
ave an inverted conical form. They are
pen fields close together, surrounded and
ed by a covering of turf and mould. The
iameter is about eight feet. They are
the bottom with wood, and then heaped
um-stone, which appears above the fur-
s an accumulated cone, nine or ten feet
hich is nearly answering to the depth of
nace. Then fire is set to the wood by a
vent near the bottom, and the whole is
own in about three hours' time; which
ey told me, the requisite time for burn-
ter which the heated stones are carried
oiling-house, distant about one Italian
m the quarries. Here they are put into
its, or square wooden reservoirs, half sunk
e ground; where they are steeped in a
ient quantity of water, which, after suffi-
issolution of the alum, is by troughs con-
nto the alum-house, and in large square
settlers, that the dregs may settle at the
. This done, the clear lixivium is poured
ass pans, and, after sufficient boiling, con-
into wooden coolers, on whose sides the
rystallises white and reddish. Before the
ted brine be conveyed into the cooler,
op it for some time in the troughs, in

order to facilitate the precipitation of selenite; and in the boiling they liquor some lime and urine*.

" The supports of the pans are lava, with large white crystalline whose quantity exceeds the mass minating lava. It is found, as they large loose pieces, at nine or ten from Tolfa; and it resembles n h a volcanic hill called St. F , : which I have seen, and shall lowing letters.

" The Tolfa alum-mines are discovered in former times by ing been long time a slave in there in some alum works, guessed *aquifolium*, common about Tolfa, must be alum in the neighbourl shrub is found in many plac discovered."

It is evident from this account rocks of Tolfa are very differ fr slate, which shall be afterwards

---

* " If this be the case, the selenite is in no part of the Tolfa alum-stone, as the author se pose." Raspe the translator, whose la

STRUCTURE I. MASSIVE ALUM ROCK.

Characters.

xture, granular; on a large scale somewhat
fied.
rdness, gypsic. Fracture, earthy or uneven.
ients, amorphous, not sharp.
ight, carbonose.
stre, dull. Opake.
lour, greyish white, greyish yellow, or yel-
white. Bergman found it to contain about
sulphur and other volatile matter; 35 argil;
ex; and some iron.
. Kirwan says, that veins of this kind have
discovered in Bretagne; but when he sup-
that the Roman alum also runs in veins, he
adicts the ample account of Ferber, no in-
até observer, who formally and repeatedly
ns us that it is extracted from a rock consti-
hills, and containing veins of quartz*.

STRUCTURE II. ALUMINOUS SLATE.

Characters.

is substance abounds in many countries.
er divides it into the common and the
'.

---

e name Roman alum is now also given to the finest,
r fabricated.

Texture, schistose.

Hardness, gypsic. Fracture, sometimes st sometimes waved. Fragments, laminar.

Weight, from carbonose to granitose.

Lustre, glimmering; the glossy kind Opake.

Colour, greyish or bluish black. It slate celebrated by the vulgar for its perties.

Aspect 1. Common. This is generally the British manufactories of alum. The specimens are from an old coal-mine near gow, in Scotland.

Alum slate, from the vicinity of G

The same, with some small appeara alum.

The same, more expanded or dec beautiful fibres of alum, like amianthu

The bituminous shale of Kirwan*, ranks it with alum slate, seems to bel ferent mode. Pyrites sometimes alum, vitriolic acid being formed by t sulphur, which, by exposure to air slowly re-acts on the argil, and forms

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* ii. 19.

ect 2. *Glossy.* This, as already mention-
s rather a metallic appearance, and is some-
tarnished like peacock coal. In the north
nce it is sometimes found singularly hard
mpact.

ect 3. *Alum earth.* This is found com-
nd of a brownish black colour.

MODE II. CLAY SLATE.

must not be confounded with the argil- **Distinctions.**
s schistus of Kirwan, which is here called
and assigned to the Siderous Domain;
clay slate is the schistose clay of Kirwan,
he also calls shale, and which is often
over coal, bearing vegetable impressions.
argillaceous schistus, or argillite, of Kir-
s the *thonschieffer* of Werner; while, by
e a distinction, his *schiefferthon*, the slate
f Kirwan, is our clay slate. Brochant
it *argile schisteuse.* It is less hard and
y than siderous slate, adheres to the
, and softens in water. But all their de-
ons chiefly refer to that kind which is
in coal-mines; while the most important
n is that which forms entire mountains, as

among the Andes in South Ameri many other metallic regions. This is very far removed from sider commonly quarried as valuable in being less ferruginous, and far schistose, so as sometimes to be even c with grauwack. The necessity of nations in mineralogy is also appar example; for while we are told by Mr. that the Andes chiefly consist of argillite, one would expect an univ tory of slates for architecture; while such appear, and the substance is a slate, slightly impregnated with i manner Mr. Jameson must m substance when he gives us the f formation.

"Clay slate is one of the most of the primitive rocks. It conta venigenous formations that occur ing primitive rocks, as tin, l silver. Very considerable metallif frequently occur, and these c rites, red copper ore, cop azure, malachite, iron pyrites, n glance cobalt, grey cobalt ore, blend and lead glance. Gold also formation, and it is said also cinnabar.

a very widely-extended rock. In this t skirts the Highlands, from Lochlo- Callender, Comrie, and Dunkeld; in of that extensive district resting on, ally passing into, mica slate: the same ces are to be observed in many other in Scotland. On the Continent of has been traced through a great extent y: thus it occurs in Saxony, Bohemia, ranconia, Bavaria, the Alps of Swis- Austria, Hungary, and many other urope. It occurs also in considerable in North America, as Pennsylvania; mmense quantity in South America: said that nearly the whole country Potosi and Lima is composed of it."* lf-evident that a wide distinction should between this important and universally ubstance, and the siderous slate which architecture.

mineralogy, Mr. Kirwan seems to have he primary and secondary argillaceous when he mentions that it sometimes ressions of vegetables and shells†; but ological essays, which are valuable as

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y, 125.

vale of Chamouni it is found impressed with am-they present a mass of information, compil with great labour from German authors known in this country, he has dist them, by the divisions of his work, into tive and secondary rocks. His account primitive clay slate is as follows:

Kirwan's account.

"It forms whole mountains, Voigt P But more commonly only partially them, as in Saxony, Charp. 175. Or strata, as at Zillerthal, in Tyrol. Its m are of gentle ascent.

Primitive.

"There is no doubt of its being tive, for in Saxony it frequently alter gneiss and schistose mica. 3 Helvet. 1 Berg. Jour. 1792. 536. And with lime-stone. 8 Sauss. 144. And in nular lime-stone is found betwixt 1 Berg. Jour. 1791. 306. We that both granite and gneiss often Both Karsten, 3 Helvet. Mag. and 25 Roz. 85. sufficiently establish t There are two sorts of it particu attended to, the *harder* and the *softer*; harder border upon, and often pass i ceous schistus, or basanite, or hornb The softer border upon, or pass into, t wacken, or rubble stone, or rubble slate, ticular slate, or indurated clay, and the harder often graduate into the softer. 3 Nev. Nord. Beytr. 169. Or border upon the *muriatic genus*, and pass into schistose chlorite, or schistose talc, r gneiss, or schistose mica. It often contains quartz, both in veins and betwixt its laminæ. oigt Prack. 41. More rarely felspar, schorl, arnets or hornblende, and granular lime-stone. Berg. Kal. 205, 206. The softer sorts are remarkably metalliferous. Berg. Kal. Voigt Prack. 0. The famous mountains of Potosi consist of t chiefly. 1 Berg. Jour. 1792. 545. In Saxony t is found in primitive lime-stone. 2 Berg. Jour. 792, 134; and often mixed with it, as in Leske, . 328. It is so much the more siliciferous as it pproaches more to granitic mountains. Lasius, 21. It passes into rubble stone. 2 Berg. Jour. 1788. 498. In the argillites of the Pyrenees no organic remains are to be found. Descrip. Py-en. 27. Saussure found it in the snowy regions of Mont Blanc. 7 Sauss. 256."*

Of the secondary argillite, or clay slate, Mr. Kirwan gives the following description:

Secondary.

" There can be no doubt but argillite is frequently of secondary origin; Ferber acknowledges it to be partly primeval, and partly secondary. 4 N. Act. Petropol. 289. Gruner

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* Geol. Ess. 183.

found ammonites in the argillite near Mey
gen, in Swisserland. 3 Helv. Mag. 191.
specimen from Hessia, mytilites
Leske, G. 339. Voigt fo e-s
petrifactions, between strata of
neral. Abhandl. 86, 87, 88. It of
piscine remains betwixt its laminæ.
Saussure found argillitic strata inter
black marble. 1 Sauss. 401. In the
pressions of reeds, rushes, and pect
found on it where it adjoins to r
Lasius, 103. 105. Sometimes it r
grows more siliceous, from the b
Lasius, 105. Sometimes it is har r
than lesser depths. Idem, 102. In t
alternates with, and sometimes is
mixed with, rubble stone. Lasius, 1
passes into sand-stone. Idem, 105.
culla it alternates with alumin
marlite. 29 Schwed. Abhandl. 26."

In the account of siderous s
observed that it contains from 10 to
Dr. Townson has given an analysis
ceous schistus, or clay slate,
silex 60, magnesia 9, iron 6,
leum†. The last is accidental, and

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* Geol. Ess. 241.

† Philosophy of Mineralogy, p. 57.

eans shale incumbent on coal; but from 4 to of iron may be considered as commonly beonging to clay slate, while the siderous or common slate, eminently so called, contains from 10 o 20.

Ferber's primitive slate is argillaceous, with articles of mica, and crossed by veins of quartz, hich more rarely happens in the siderous ind; and it often appears in undulating strata. Ie adds, that in the Vicentine and Veronese erritories it is regarded as the deepest rock, any ubjacent granite not having been discovered. t contains as usual metallic veins, which often un between it and the incumbent lime-stone*. Patrin has little enlarged on clay slate, though a rock of the first importance; but indulges his imagination, that the vast beds of clay have been produced by muddy eruptions of submarine volcanoes.

Hone.

The fine stone used for sharpening razors, called a hone, is commonly a clay-slate, containing, like the others, about 60 parts of fine silex. It is often of the cameo kind, or disposed in layers of different colours, the upper of a whitish yellow, and the under of a reddish grey;

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* Italy, 37. Da Costa, p. 165, says, the black slate of Glaris, in Swisserland, which rises in slabs, contains impressions of plants and fish; and is of course secondary.

the first being of a finer grain, while seems to graduate into the stone used for ening scythes, and which, from t grains of silex, becomes an argilla stone. Patrin informs us that hon in the mountains of Jura, and the V the substance was found on diggi extreme depth, at Hampstead, near I

Chinese cameos.

Clay slate has seldom been used mental purposes; but the Chinese, a m ligent and ingenious people, and a the most moderate computation, to hundred and thirty millions of souls, of the human race, have rivalled the converting to utility and ornament articles of the mineral kingdom; the rest, this substance has not attention.

" The cameo slate of the Chin primitive argillaceous schistus, of paste, softer than the hone, and w three, or even four, successive lay of different colours very neatly di strongly adhering to each other.

" The Chinese artists have availed t of the disposition of this stone. They

* i. 123.

ievos or cameos of it, of most exquisite :ship, and sometimes of considerable saw a picture made of it in the Imperial of Petersburg, more than two feet in epresenting a landscape, with figures of animals. These objects were of three colours, white, green, and red; the of a coffee colour, made the fourth. d specimens of the Chinese cameos are several cabinets at Paris, and especially :ollection belonging to the Council of *

e piece of the same kind appears in the llection of M. Dedrée, brother-in-law of u. Some may also exist in England; ugh we carry on the chief trade with here are not so many singular Chinese in London as in Paris. The Chinese balls, for example, are not known in They are used by the Mandarins clined to sleep, the mere heat of the oducing various sounds, like those of the Eolus. Faujas had one dissected, when und to consist of minute wires of steel, is sizes, disposed according to some arti- es. The first Parisian artists acknow-

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* Patrin Min. i. 124.

ledged their inability to produce such a singular machine.

Antique. Clay slate was also occasionally used in the arts by the ancients, for Wad, in his catalogue of the Borgian Museum, has mentioned a fragment of a small statue of a bluish grey slate, the surface being white from decomposition. There are also heads of battle-axes, of a grey clay-slate, veined with a deeper colour, probably from some island in the South Sea.

This substance is often singularly contorted in various fantastic forms, both on a large and on a small scale.

Gmelin supposes that the softer clay-slate [illegible] from the decomposition of the harder granite [illegible] says that rock clay is sometimes used in building*. Dr. Buchanan, in his travels in the south of Hindostan, observed a kind of clay, which when dug up and dried, becomes as hard as brick, whence he has not improperly called it

Laterite. *laterite.*

The materials concerning clay rock and clay slate are unusually scanty, not only because they are seldom used in the arts, but because even geologists have paid far more attention to the granitic and calcareous rocks than to the ous, which are however of vast extent t importance.

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* Linn. 137.

Andes.

iost authentic and scientific account of truction of that vast chain of mountains es, is contained in the travels of Helms, n mine-master, who was appointed to e Born's method of amalgamation into vian metallurgy. He remained in that from 1789 to 1793, and in 1798 pubs Journal, containing his daily observade on the spot. In the English transr rather abridgement, the translator, of their consequence, has omitted many it particulars; but enough remains to e construction of this magnificent and chain, which astonished our author by rupt irregularities, and such various alns of their component parts, as he had eheld in the mountains of Hungary, or the Pyrenees. In no country, he ies a revolution of nature appear to have general as in South America, and the re every where discoverable.

further premising that he travels from Ayres to Lima, across the chief region Andes, his scattered information on this nt topic shall be brought before the n one point of view.

ring the journey to Tucuman we found

the mountains composed of primitive
but as we proceeded, the granite ie i
mixed with argillaceous slate of vari s c
that however which chiefly predomi
Cordilleras is of a bluish cast, as far
we had an opportunity of exam
Strata of lime-stone, and large n
ginous sand-stone, are in many p
incumbent on the argillaceous slate.
wise found on the road coal, gypsum,
salt; the last even on the summits of
elevated ridges."

In the bed of the river R
observed blue clay slate; and he
to find the highest snow-capt m
nine miles of Potosi, covered with a
stratum of granitic stones, rounded by
of water; while there is a conti
Tucuman, where the granitic rid
from Tucuman to Potosi it co
clay slate.

"The mountain Potosi, at w
city is built, resembles a sugar-loaf:
eighteen miles in circumference,
composed of a yellow very firm
slate, full of veins of ferruginous
which silver ore, and sometimes britt
ore, are found interspersed."

On his journey from Potosi to Lima,

at Alcacado clay slate, interspersed with masses of granite; and afterwards red sand-stone on the clay slate. They afterwards alternate, and the slate is covered with thin moss.

The rich city of La Paz is built at the bottom f the highest part of the Andes, covered with verlasting snow. In a fragment of the rock, eing a glutenite of yellow clay and rounded lints, lumps of pure gold were found, weighing rom two to twenty pounds. Puno, which is lso one of the highest parts of the Andes, pre- ents mountains of fine clay slate, abounding in ich ores of gold and silver.

Passing through Cuzco he arrives at Carretas. 'The base of argillaceous slate is covered with an alluvial superstratum, which consists of marl, gypsum, lime-stone, sand, a large quantity of rock salt, and of fragments of porphyry, &c. in which pure silver and rich silver ores occur in abundance. There are few instances in Europe of such mountains so generally abounding with the precious metals, or their ores, as in this quarter of the globe. The whole ridge appears to be full of alluvial veins of heavy silver ores, in which pieces of pure silver, solid copper, and lead ore, occur, intermixed with a great quantity of white silver ore, and capillary virgin silver. Thirty-six miles before we reach

Guancavelica, behind Parcos, lie mou weather-beaten argillaceous slate, mi sand. The sections of these mounta c entirely of separate, more or less sharp pyramids of a flesh-coloured sand-st

"The ridge of mountains covered over which the road to the Pacific O consists of simple sand-stone, thr metallic veins, in some places wi felspar, in others with steatite and openly appear. On the contrary, mountains to the north of Guamanga cavelica is said to consist, to the ex hundred miles, of simple lime-stone, abounds with metallic ores, espec province of Tarma."

"Behind Guancavelica the dually become composed of less rials, and at last consist only of stone, with layers of marl, lime- r, or of simple lime-stone; they conti er equally rich in gold, silver, quic , salt, &c."

It further appears from the or the clay slate, which chiefly com nificent chain of mountains, is of ful colours; blue, dark red, fl c and yellow.

In chemical analysis it has sometimes hapened that the chemist has ably performed his ask, but has mistaken the name of the subtance. In like manner it was here necessary o identify the rock, before proceeding to its escription. It has before been observed that it ay be divided into two kinds, which at the me time vary considerably in their structure, amely, primitive and secondary.

STRUCTURE I. PRIMITIVE CLAY SLATE.

Characters.

Texture, schistose, sometimes in thin layers, ut more generally they are thick and coarse; ne-grained, sometimes almost impalpable.

Hardness, marmoric, sometimes gypsic. Fracure, slaty, sometimes approaching to earthy. ragments, amorphous, tabular, with sharp angles.

Weight, carbonose to granitose.

Lustre, sometimes dull, often silky. Opake.

The colour is most usually grey, of various ints; but it may also be found of a straw yellow, nd various hues of red. It sometimes presents treaks of a bluish white, or is mottled with vaious illinitions.

Yellow clay slate, from Potosi.

Grey, from the Andes, Saxony, Scotland, and ther metallic countries.

Pale blue, with cubic pyrites, from Yorkshire.

The same, with dendritic pyrites.

The same, singularly convolved, from of Dauphiny, and many other regions.

Thick clay slate, intersected in all with veins of quartz, from Scotland.

The same, with calcareous spar, fr

The same, with veins of quartz c ralds, from the celebrated emerald-ı in the Viceroyalty of New Grenada. It d appear that Peru ever produced any emeralds.

Massive clay slate, or perhaps rather clay rock, from Ronneburg.

Clay slate, in rhomboidal fragments, terbach.

Thick clay slate, with a coarse-g fracture, from Upper Lusatia.

Green clay slate, with calcareous spar, Shneeberg.

The same, with cinnabar, from Idra.

Clay slate, with yellow blend, from Transylvania.

From the Ganges.

Specimens of clay slate, collected Ganges, and its vicinity, by Colonel Ha on his journey to Siranagur.

Clay slate, from the rocks about G

The same, of a silky appearance, a

magnesia, from the rocks near
f an ash grey colour, and finely

ous clay slate, from Coadwara.
, veined with dull green, from

lay slate, which alternates with
, in the hills near Adwaanee.
ined 45°.
te, found in thick strata near

in layers of different colours,

te, from high mountains near

slate, of a bluish grey, from

, intersected with quartz veins,
y slate tufa, from Bedeyl.
sected with quartz in all direc-
ne.
brownish red, and various other
ore.
e, in bowlders, found in the bed
, near Siranagur*.

---

ere presented by Colonel Hardwick to the

European. To the European may be added,—

Micaceous clay slate, from Mont Blanc.

Clay slate, mingled with chlorite, Blanc.

Purple clay slate, with spots of q mica, and thin layers of talcous schistus, same.

Soft grey clay slate, from the same.

Grey clay slate, sometimes spotted w posed pyrites, from the summit where it rests in beds nearly horizontal, or uprights of schistose keralite.

A remarkable clay slate, of a yell with long streaks, so as to have t oak board, with some knots of a dee and others white. It is mingled quartz and mica. Sauss. § 1482.

STRUCTURE II. SECONDARY.

This either occurs uniform, or with of vegetables, or sometimes of shells.

Aspect 1. Uniform. Thick slaty Derbyshire.

Shale, from numerous coal-mines.

Variety. Bituminous shale, from the same.

Aspect 2. With impressions. Shale, with the pression of the skeleton of a fish in a lighter lour, from Hessia.

Shale, with the impression of an ammonite, om Chamouni.

The same, with impressions of various vegebles, chiefly gigantic ferns, from various coalines.

Variety. Bituminous shale, with various imressions.

Black chalk.

Hone.

There are two substances often found in clay slate, and considered as of a kindred nature, but they never appear in the form of rocks. 1. Black chalk, so called because it is used in drawing, and which, according to Weigleb, contains 11 of carbon. 2. Hone, which is as proper and sonorous a name as novaculite, or whet-slate. Some lay slates and sand-stones form the coarser whettones, used by cutlers. The finest hones are aid to be brought from Turkey, but they are also said to be found in the neighbourhood of Namur, n Flanders. Brochant says that it is also found n Bohemia, in Saxony (Seifensdorf, near Freyerg), in Siberia, in Stiria: lastly, at Lauenstein, n the Margraviate of Bareith, where it is wrought. It often seems to form the passage to indurated alc, and is sometimes covered with efflorescences

of sulphate of magnesia, which has led to a belief that talc is one of its constituent ts;
Werner also suspects, from its unctuo
being often of a greenish tint. It t u
presents two layers; the upper of a
yellow, and the under of a blackish
fracture is often scaly, which is seldo
in other schistose substances; but that
sometimes presents a slaty fracture,
proaching to the conchoidal, and partly
earthy. Hone seems nearly related to a
indurated fullers' earth, and is said by
decompose into tripoli*.

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* Saussure says, § 1594, that the common
posed of little white grains of quartz and f r,
ferruginous clay. The hard black nod h
slate, likewise afford very good touch-stones.
form a kind of file, which seizes on the
while the black gluten displays the colour. And
affect the stone, the trace may easily be tried by th
by the aqua regia.

MODE III. CLAY ROCK.

Characters.

, of a fine earthy grain.
ss, marmoric, sometimes gypsic. Frac-
rally even, sometimes flatly conchoidal.
approaches to clay slate. Fragments,
s, rather blunt.
, granitose.
dull. Opake.
the *thonstein* of Werner, which forms
s, and is the base of his clay por-
ich will be described among the Ar-
Intrites.

countries, such as the Salses of Mo-
e Crimea, and near Girgenti in Sicily,
nasses of indurated clay are produced
lar cause, the eruption of what are
ddy volcanoes. Dolomieu has mi- **Eruptions of mud.**
scribed that of Macaluba, near Gir- **Macaluba.**
circular mountain, about 150 feet in
terminated by a plain somewhat con-
about half a mile in circumference,
urmounted by a great number of trun-
es, with little craters like funnels.
n which they rest is a grey dry floor,
ers a wide and immense gulf of mud.

There arises every instant, from the
the funnels, a wet greyish clay, with c rex
surface. This bladder, bursting with n
throws beyond the crater the clay, w
like lava down the sides of the little
intermission between the petty expl
between two and three minutes. T
also more important fermentations, t
affects to imitate a volcano; little
are perceivable at the distance of
miles, and there are serious eru
sometimes elevate a sheaf of liq
height of 200 feet; the explosions
three or four times in the twenty-
and accompanied with a fetid sul
This singular volcanello has been d
Strabo and Solinus; and the ot rs
same phenomena. Patrin says t
of a greyish blue, and that S
in it the same elements as in
mieu has also observed that the
cover the surrounding country, e
of those eternal ejections menti

When clay rock is strongly im
iron it passes into jasper. The
colours are grey and red, and it is

---

* Dolomieu, Lipari, 153. Patrin Min. v. 249.

or striped. Mr. Jameson, in his Mi- r, has promised a more particular ac- f *thonstein;* which he has not however lished in his Geognosy, where he only us that the Pentland hills, near Edin- present examples. Dr. Babington, in logue, mentions clay porphyry from the of Edinburgh; but gives no examples clay rock, which seems however to form part of that vast chain of mountains the In Chili entire mountains are com- f brown or black clay rock.

substance frequently occurs in coal and ines, where it receives a vast variety of ial names, according to the fancy of the In coal-mines it is commonly a shale, ernates with beds of sand-stone, which such circumstances receives fanciful de- tions*.

rock, from Saxony.

same, from the Andes.

same, from Pentland hills.

---

t is called the clay-bed of the Leadhills, in Scotland, n the softness of tough clay, to the hardness of striking teel; in the language of miners, *from mell and wedge to* and this too at a depth from forty to fifty fathoms. smahago, Lanarkshire, is a lead-mine in clay slate: the g in a vein of sulphate of barytes, five feet wide. G. L.

Saussure, § 1944, describes a kind of clay ro found among the pebbles of the two rivers ca Emme, in Swisserland. This substanc hitherto little engaged the attention of i ogists or geologists, all the accoun imperfect.

Porcelain clay. Porcelain clay sometimes constitu but it is merely a decomposed fels may be found in the Domain entitled l posed Rocks. Potters' clay seems only to in separate strata; when of a greyish wh is called pipe-clay. The clay of famous Egyptian vases have been many thousand years, is, according to of a marly nature, and is found near C the Thebaid. It approaches to the lour, and is of a porous and light c Porous vases which, by evaporation, great coolness to water, are also n in America, where the ladies are even ing the fragments*. Molina, in his account of Chili, has described several clays, of which there is one which long r sweet smell.

Boles. The Lemnian, Armenian, and other boles, rmerly celebrated as absorbents, and which 'e now supplanted by magnesia, are merely ne clays, which contain a small portion of iagnesian earth. Hence they somewhat ap- roach in their nature to the fullers' earth of erkshire, and Ryegate in Surry[*].

---

* Da Costa, p. 20, says it is a bole useful in acidities, and as a dentifrice.

The earth called almagra, which is used to npart a red colour, and an unctuous feel, to panish snuff, is found at Almazaran, near Car- hagena, in Spain, and seems a fine ferruginous lay, perhaps with a mixture of magnesia.

MODE IV. WACKEN.

Characters.

Texture, sometimes compact, sometimes vesi- ular. When the vesicles are filled with para- tic stones, it is called amygdalite; but as the ıse of the latter is more frequently a trap or ısaltin, it has been classed after that substance.

Hardness, marmoric, sometimes gypsic. Frac- ıre, commonly even, sometimes approaching ıe flat conchoidal. Fragments, amorphous, ther blunt.

Weight, granitose.

---

[*] Bergman has put Hampshire, in which he is followed by all foreign mineralogists; but there is no fullers' earth in Hamp- re.

Lustre, dull, sometimes faintly glimmering.
Opake.

The usual colour is grey, sometir
ing to black. It may also be brc
iron ochre. Wacken someti c
but this mixture cannot be n l
teristic, as appears from the amygc

Wacken is ranked by the Gern
ogists as intermediate between
Like basalt it sometimes pre ı
never contains augite or olivine. It
as secondary, because petrified
found in it: but such arguments are
fallacious, for the detritus of a
may again consolidate, as in the (
and it is easily conceivable that it n
velope substances foreign to its
ation.

Wacken is often a *cornéenne*, or p
of the French mineralogists. The
the Germans is a very different su
will be described among the Argil
tenites.

Wacken, from Saxony, &c.

MODE V. SMECTITE.

ubstance is commonly called fullers'
it as the latter word would here seem
olecism, it may be preferable to adopt
t denomination.

e, earthy, sometimes with a very fine Characters.

ess, cretic. Fracture, uneven, some-
e conchoidal. Fragments, amorphous

, carbonose.

dull. Opake.

lour has often a greenish tinge, which
from a very small portion of mag-
t as this scarcely amounts to 1 in 100,
o reason for classing it among the
n Rocks; especially as in that from the
Cimolus, which is superior even to the Cimolite.
Klaproth could discover no magnesia,
ous feel arising from the mere purity
y*. In general fullers' earth would Fullers' earth.
judged of a light brown colour. The

---

a has observed that great fineness of the grain will
an unctuous feel.

coarser sort at Ryegate, which contains cry of barytes, is of a reddish brown, and is not in commerce.

The analysis by Bergman bears tl fullers' earth comes from Hampshire, followed by a hundred mineralogic ; it was probably from Reading, in Be for in the vicinity of that town there are r quarries, which lie under beds of mingled with numerous shells of oysters. I also found near Woburn, in Bedfor Ryegate, in Surry.

Da Costa informs us, that fullers' ear at Wavendon, near Woburn, in] For about six yards there are laye sand, then a thin stratum of sa sand again for seven or eight yards; fullers' earth appears for about ei lowed by sand-stone and sand. At and Nutfield, in Surry, the stra ; but at Detling, near Maidstone, in derlies a sandy loam, mixed with a of shells. It is prevented from ng by a special act of parliament*.

Near Reading oyster-shells are f bottom of a high hill, a hundred feet rface. They lie on chalk, covered with sea nd, which still retains its brackish flavour. bove that is fullers' earth, nearly eleven feet in epth, and then chalk, and different kinds of ay; then a common sort of sand: and so on the surface, which is gravel.

---

* Nat. Hist. of Fossils, 1757, 4to. p. 69.

It does not effervesce with acids, nor is it dif- sible in water, in which it does not froth like ap, as some have asserted. It is used in what called the fulling of broad cloth, an operation hich consists in extracting the grease.

Abroad, it has been found in Saxony, Alsace, nd Sweden, always forming beds of more or ss thickness. In England it commonly ap- ears between beds of sand-stone.

The earth brought from Cimolus, which is described by Pliny as used in medicine and in bleaching, has again been discovered, by Mr. Hawkins. It is mingled with small particles of uartz; but this circumstance does not prove it o be a decomposed granite, as an accidental nixture of silex occurs in many substances.

Fullers' earth, from Reading, in Berkshire.

The same, with incumbent sea sand and yster-shells.

The same, from Ryegate, in Surry.

The same, of a coarser kind and darker co- our, with imbedded crystals of yellow barytes.

Mr. Sowerby has a large regular crys kind, equal in beauty to a topaz.

Smectite, from Cimolus, one of t the Grecian archipelago,

MODE VI. ICONITE.

This substance is only known by images brought from China, whence is imposed. From its unctuous ap was long imagined to belong to tl Domain, till Klaproth's analysis the Argillaceous. It contains, 24; lime, 1; water, 10; a com nearly corresponds with the smect lus. The abundance of water seen some other substances, to impart appearance; but the refinemen chemistry may perhaps discover ticular in the composition of this

The Germans denominated t bildstein, that is, image-stone, has translated *agalmatolite*, while used the far shorter term here adopted.

Bildstein. *bildstein*

---

* The analysis approaches that of chalced , v unctuous appearance, perhaps from the admixt

premised, that sometimes the red or loured stone, more rarely used for the urposes by the Chinese, really belongs to gnesian kind.

roth mentions two kinds of iconite, the rent and the opake; the former unexy presenting a third more argil, and only water of the latter.

STRUCTURE I. TRANSPARENT.

roth describes this sort as being of an olive agus green, verging through various tints enish blue. The interior aspect is very g, and of a greasy lustre; the fracture

STRUCTURE II. OPAKE.

according to Klaproth, is reddish white, l, and with variously-coloured veins; the is less distinctly scaly; the lustre dull, out somewhat translucent on the edges.

ier has rightly added to the colours of the the greenish grey, of different degrees sity, the yellowish passing into yellowish ngled with green, and into pale yellowish The greyish white seems to be one of t common tints of this substance.

Du Halde, in his description of Cl
tions that the district of Tay-tong-fû,
Yu-she. to Shan-si, furnishes the most beauti
which that author, in the confused mi
the time, calls a kind of white jasper.
that it resembles agate, is transparent,
times appears spotted.

Goez, who travelled to Tibet in 1
scribing Yarkand, the capital of the k
Kasgar, in Little Bucharia, mentions, t
modity, particularly acceptable in Ch
kind of marble or jasper, found in
"The king of Katay buys it at a gr
what he leaves, the merchants sell to c
exceeding great rates. Of it they
ornaments for garments, and girdles,
toys, whereon they engrave leaves,
other figures. The Chinese call it *Tus* [†].
are two kinds; one more precious,
flints, which are found by diving
Kotan, not far from the City Royal:
meaner sort is digged out of quarri
into slabs above two ells in breadth.
where they are dug, called K

---

[*] Green's Voyages, iv. 645.

[†] In the original *Tusce*, a mistake, no doubt, for Y
word used by Du Halde. There seems great reaso
the *pocula murhina* of the ancients were of this sub

stony mountain, is twenty stages from the
:ity. This marble is so hard, that they
often it with fire to get it out of the quarry.
ing farms it every year to some merchant,
arries provisions for the workmen for that
f time."

precious substance, if we judge from its
ss, cannot be the present article; but is
ly that beautiful jad (though perhaps fu-
liscoveries may impose a different name),
is brought from Tibet and China in the
f small basins, sword-handles, &c. It some-
esembles chalcedony, but is far more pond-
The chemical analysis and proper classi-
n of this singular substance remain among
siderata of mineralogy, though specimens be
common in various great collections.

DE VII. ARGILLACEOUS INTRITE.

e argillaceous intrites and glutenites are of
gious extent and importance. The chief
, commonly called clay porphyry, as con-
of crystals of felspar in a base of clay, is
imes a principal material in vast chains of
tains. The argillaceous glutenites, called

grauwack, sand-stone, &c. form ex
gions of the earth.

STRUCTURE I. ARGILLACEOUS INTRITE, WI OF FELSPAR.

Clay porphyry.

This substance forms large moun
Hungary, and sometimes contains c
carnelians, amethysts, or zeolite*.
Werner it is either primary or sec
latter containing branches and ro
tire trees, petrified; as, for ex
nitz in Saxony. The primitive
phyry has commonly a red
much in hardness from genuine

This intrite forms a considerable
Andes, and of the metallic moun
Spain. The *saxum metalliferum* of
is also a clay porphyry, but is ju
among the Decomposed Rocks. Gr
has arisen, as has already been
arranging the porphyries in one family;
ought to be classed as intrites, acc
various bases.

Clay porphyry, from the metallic
New Spain.

---

* Kirwan Geol. Ess. 206, 207.

The same, from Lower Hungary.
The same, from Pentland hills, near Edinburgh.
The same, with petrified wood, from Saxony.

STRUCTURE II. WITH VARIOUS CRYSTALS.

Argillaceous intrites are also found with inlaid rystals of quartz, calcareous spar, zeolite, and ther substances.

ODE VIII. ARGILLACEOUS GLUTENITE.

There is scarcely any bricia which belongs to is Domain. Born indeed mentions a clay icia, consisting of fragments of his metallic ck, joined by an argillaceous cement[*]. Fragents of clay slate are also found united by a ongy argillaceous tufa, an evident decompotion of the substance by water. But these inances are rare, and of little moment.

That kind of glutenite called pudding-stone so falls rarely under this Domain, the cement eing commonly siderous or siliceous.

The argillaceous glutenites may as usual be ivided into the large and small grained. Even e grauwack of the Germans, the most generally diffused of this kind, may rather prete the latter denomination, as where the are large, they are commonly inters considerable distances.

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[*] Raab, i. 414.

STRUCTURE I. LARGE-GRAINED ARGILLACEOUS GLUTENITE.

In arrects.

The most remarkable rock of this l described by Saussure, who discover pectedly in a vertical situation, in the Al Valorsine. In 1776, and afterwards in 17 visited the mountain of Balme, which g to the river Arve, and made the foll observations, which chiefly contributed his system of *refoulements* or subversi which unhappily he does not explain but implying that the rocks now found were formed in a horizontal position, afterwards elevated by some cause o contrary direction from beneath or

Valorsine.

"The base of this mountain is a g y granite, with grains of a middling s , structure nothing remarkable. But granites are found schistose rocks of quartz, and felspar; an intermediate kind of rock l granite and common mica slate. Their run from north to south, as does the valley alorsine, and form an angle of 60 degrees the horizon, leaning to the west, against the r. These rocks are continued in the same ion for more than half an hour's walk; they st sight of under the verdure which covers a plain, situated in the midst of woods, and is called *le plan des Ceblancs.*

---

* The French of the Swiss writers in general is im sometimes requires a particular dictionary, as they *think* in Swi German.

From thence, ascending obliquely on the south great blocks of grey schistus, or of a violet re found, sometimes even of a decided violet r, which contain a great quantity of foreign es, some angular, others rounded, and of ent sizes, from a grain of sand to the size of ead. I was desirous of seeing these pud- stones in their native place. I went straight to get to it: but there, how was I surprised d their beds vertical!

This surprise will easily be conceived, when considered that it is impossible that these ling-stones could have been formed in this ion.

That particles of the greatest tenuity, sus- ed in a liquid, may be agglutinated among selves, and form vertical beds, is what we r conceive, and of which we have proof in nstances of alabaster, agates, and even in artificial crystallisations: but that a ready stone, as large as the head, should stop middle of a vertical wall, and have till small particles of stone shou c round it, cement it, and fix supposition at once absurd and must then be considered as a thing that these pudding-stones have been horizontal position, or nearly so, after their induration. What is has elevated them? It is what, ignorant of; but it is already one an important one, to have found, digious quantity of vertical with in our Alps, some, which we tain have been formed in a horiz

"Even the nature of the sul velopes the pebbles of these puddi ders this fact more curious, and For if it was a misshaped and c might be thought that these pebbl which cements them, were thrown some vertical crevices, where the liq ened by drying. But on the c of this paste is of admirable r ness; it is a schistus, whose el y are extremely thin, mixed with mic parallel to the planes which divide t

Those beds themselves are very regular,
:onnected, and of different thickness, from
n inch to several feet. Those which are thin
in few, and sometimes no foreign pebbles;
ome alternations are observed of thin beds
ut pebbles, and thick ones which contain
The colour of the base of this schistus
considerably; it is grey, greenish, most
violet, or reddish; some is also found
led with these different colours. These beds
a direction from north to south, exactly like
of granitoid rocks, which are under them;
e inclination of the schistus in much greater,
ls are often nearly vertical; and when they
t, they rise some degrees on the same side as
cks I have just mentioned, that is, towards
est.

The pebbles buried in this schistus are, as I
said, of different sizes, from a grain of sand
or seven inches diameter; they all belong
t class of rocks which I call primitive; yet
e not observed massive granite; only laminar
te, laminar rocks, blended with quartz and
; even fragments of pure quartz, but posi-
no schistus purely argillaceous, nor any
stone; nothing which effervesces with aqua-
and even the paste which contains these
s does not. Their form differs; some are

rounded, and have evidently lost their ang friction; others have all their angles sharp; even have that rhomboidal form that rocks so often affect. In those parts where these pebbles are imbedded in tities, the elements of the schistus room to arrange themselves, and laminæ; but every where, where the between them sensible intervals, the la appear, and are constantly parallel, both another and with the planes which divide

"The mass of these schistose constitutes a thickness of near 100 mountain, reckoning from east to beds; and I traced it in the direction for more than a league: it cannot be ther, because the beds hide themselves, buried under the earth.

"Above these pudding-stones, to slate is found, of which the beds inclined, and the direction a little d tend some degrees more to the east, Col de Balme, but they lean to t those among the beds of pudding-st are not quite vertical: they lie towar

"In continuing to ascend, thin beds stone are found above the slates, which same situation and inclination with

ese sand-stones are other slates; then thin
of bluish calcareous rocks, mixed with
; then the same stone with very little mica;
hen again the same in thicker beds without
ixture of mica.

Then the same succession recommences: first
stone, mixed with mica and quartz; on these
stones, in thin layers, mixed with mica and
z; then the same, in thin layers, almost
ut any mica; and lastly the same, in thicker
, entirely exempt from mica.

Here the vegetable earth almost entirely co-
the summits of the layers; only here and
two or three feet above the grass-plats,
nces of calcareous layers, nearly vertical,
erceived. These eminences, arranged in pa-
lines, as if they had been so placed by art,
d an appearance altogether singular.

From thence to the highest limit of Col de
e, you walk entirely on summits of slate,
y vertical, which sometimes degenerate into
ar sand-stone, mixed with mica; and such
e nature of the peak, on which is placed the
stone; bearing on one side the arms of Sa-
and on the other those of Valais, with the
of 1738. These latter layers turn more di-
y from north to south, and approach nearer
e vertical position, than the slates, which are

above the pudding-stones ; but their always towards the west.

"The entire mass of this 1181 fathoms above the sea, has by the same revolution, that is, t has given a vertical position to these beds, originally formed a For all these layers hav very position as those pud g- t bedded in the midst of the undoubtedly undergone this c sible not to believe that the parts of the mountain has o same, and that this position h expe same change by the same cause."*

Such is the account given by this g of the most remarkable a which has yet been discov d; observation, that this a others, shows the error of by some, of bricias and pud st both angular fragments and ro found in the same mass.

Bricia of Scotland.

A great part of the north of almost the whole of the Orkneys, c argillaceous sand-stone, with intersp of bricia, consisting of granite and other primitive rocks. But this bricia seems to be united by a siliceous cement: if the fragments be sometimes joined by the argillaceous sand-stone, it may be classed under this division.

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* Sauss. vol. iii. 138, 8vo.

Grauwack.

The substance called grauwack by the Germans sometimes contains large fragments of clay slate, and large pebbles of quartz; but as its grain in general is rather that of a sand-stone, it will be considered under the next structure. The German name is not only barbarous in itself, but implies grey wacken; while wacken is a rock essentially different. Mr. Kirwan says that it is the *grès-gris*, or grey sand-stone, of the French, a name very applicable; and it seems also to be the *grison* of some French topographers. The latter appellation might be adopted as at once expressive and sonorous; but as other important rocks have received appellations from the illustrious founders of mineralogy, the term Bergmanite may perhaps be preferable.

STRUCTURE II. SMALL-GRAINED ARGILLACEOUS GLUTENITE.

Grison, or Bergmanite.

The most celebrated rock of this denomination is the Grison, or Bergmanite, just mentioned, being composed of grains of sand, various in size, sometimes even kernels of quartz; which, with occasional bits of hard clay slate, and of schistose keralite, are imbedded in ceous cement, of the nature of co slate. When the particles are very sumes the slaty structure, and forms t slate of the Germans. It is the c transitive rocks, nearly approachi tive; while at the same time it tains shells, and other petrifac condary.

This important rock was formerly as being almost peculiar to the contains the richest mines; but as advanced, it has been observed in countries. The slaty grison, or Be been confounded with a clay slate; obliged to Mr. Jameson for the tinctions: 1. It is commonly of a smoke grey, and rarely presents t light yellowish grey colour of primi 2. Its lustre is sometimes glimmering of mica, but it never shows the silky slate. 3. It never presents siderite 4. It alternates with massive g not the chief distinction its aspect which has led to the trivial French *gris*, and the English ***rubble-stone***, imply that it was formed of rubbed

he rubbish of other rocks? The fracture is
different; and three specimens of various
ness, which I received from Daubuisson at
is, could never be confounded with clay slate.

‘ This rock is uncommonly productive of me-
, not only in beds but also in veins, which
er are frequently of great magnitude. Thus
ost the whole of the mines in the Hartz are
ated in greywack. These mines afford prin-
ally argentiferous lead-glance, which is usually
ompanied with blend, fahl ore, black silver
and copper pyrites. A more particular ex-
nation discloses several distinct venigenous
nations that traverse the mountains of the
tz. The greywack of the Saxon Erzgebirge,
the Rhine at Rheinbreidenbach, Andernach,
, of Leogang in Salzburg, is rich in ores, par-
ilarly those of lead and copper. At Voros-
ak and Facebay, in Transylvania, the greywack
raversed by numerous small veins of gold.

‘ The whole of the important lead-glance form-
m of Leadhills and Wanlockhead is situated in
ywack.

‘ It was for a long time supposed that this rock
peculiar to the Hartz, where it occurs in great
ntity: later investigations however have shown,
it is widely and abundantly distributed. Be-
s the Hartz, it occurs also in the Electorate

of Saxony, on the Rhine, as at E
and Oppenheim, Bohemia, Silesia,
burg, Switzerland, Pyrenees, Transyl
cany, France, and Portugal; ly I
tains in Scotland, that lie to t n h
of Forth, are principally c p d
and many, if not the whole, of the
Cumberland appear to be of the

Argillaceous sand-stone.

Another remarkable rock,
vision, is the argillaceous sand-st
poses the Orkneys, and part of t
land. It is commonly of a
more or less indurated by iron,
times decomposes in fantast r
eastern part of the Mainland
sists of this sand-stone, which
been found to be metalliferous. A
was opened near Sandlodge, the u
sand-stone, while, at the depth of 1
found a rock of keralite, traversed by
of brown quartz. The copper
an iron ore, in veins between t
the keralite. "The iron ores re
1. Dark-brown, fibrous, and n
tites. 2. Columnar bog-iron ore. 3.

---

* Jameson, Geognosy 151. In his Dumfries,
the *craigs* near that town consist of fragments
wacke, the bricia being cemented by ferrugin

on ore. 4. Iron ochre, of a brown colour. 5. talactitic iron ore, colour dark brown. 6. Earthy atter, much charged with iron, seemingly arising om the *debris* of other ores. The copper ores re, 1. Friable and amorphous carbonate of cop- er, colour rich green. 2. Beautiful carbonate of n emerald green, crystallised in capillary fibres f a silky lustre, diverging in radii from a centre: his species is found imbedded in iron ore. 3. ulphuret of copper, disseminated through felspar n some places, and in others, in great masses, in ron ore. The rich carbonates were found near he bottom of the mine."*

This sand-stone also often occurs in a schistose orm, when it is called sand-stone flag.

The Wernerians have confounded the sand-stones, as they have the porphyries, while they ought to be carefully distinguished according to he nature of the cement. The whet-stones and iltering-stones are often argillaceous glutenites, s is the important division *Cos* of Wallerius, Linnæus, and other writers in Latin. Some whet-stones are curiously spotted, commonly with dark pecks on a light ground†. According to Wal-

Whet-stone, &c.

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* Dr. Trail's Mineralogy of Shetland, in Neil's Tour, p. 170.

† Da Costa, 120, &c. mentions the whet-stone of Derbyshire s of a lax texture, easily pervaded by water, as most clays are. he grind-stone of Gateshead, Durham, also possesses this quality.

lerius, the filtering-stone from the Canary Islands; and New Spain, consists of angular particles of quartz, united without any cement; but the pure siliceous sand-stone seems the most uncommon.

Gmelin, in the last edition of Linnæus, has included *Cos* among the *Lapides arenacei*, which he rightly arranges in three divisions, with a siliceous, calcareous, and argillaceous cement. Of the latter he particularises that of Fahlun, in Sweden, where it forms the bottom of the copper-mine; and that found in many countries, where it is used for slates. The sand-stone of Derbyshire is chiefly argillaceous, as is probably the flag-stone of Oxfordshire. To this class also generally belongs the sand-stone found in coal-mines, which sometimes bears vegetable impressions. Some sand-stones present layers of variegated colours, the cement being probably argillaceous, tinctured with iron in various proportions*.

Saussure mentions the following:

Argillaceous sand-stone, in ver

arrects, which he says cannot be t

---

* Mr. Jameson says (Dumf. 166) that the c
den are of red sand-stone: argillaceous or siderous?
question may be applied to the chain of mountains behind
tlements in Notasia, or New Holland, which have b
passable. Voy. de Peron, Paris 1808, i. 393. F
chain the radical rock is siliceous sand-stone.

subsidence, but implies a "*refoulement en ontraire*, which has broken and raised beds ally horizontal." § 1166.

fine argillaceous sand-stone, speckled with § 1442.

beautiful *pierre de Moravie* seems of this it is white, with purple lines*.

---

llitzen, Recueil des Noms des Mineraux, Brunswick 1801, orn mentions a sand-stone of Siberia, containing nodules of ite. In Thuringia a sand-stone is found which is worked as of copper; and it also contains silver, cobalt, and lead. ii. 224.

Mount Rosa

DOMAIN IV.

TALCOUS.

◆

MAGNESIA.

THIS earth seems first to have been discovered, or at least sold as a remedy, by an ecclesiastic at Rome about the beginning of the eighteenth century. Under the name of *magnesia alba*, it was proposed as a universal medicine, while it could do little more than supply the place of the

ian earth, and other boles. As Theo-
tus, however, in describing the stone
l *magnetes*, says it may be turned on
ie, and has a silvery appearance, Dr.
agrees with Hill, that the ancient
ks called the load-stone *heraclea*, but
iore modern *magnetes;* and Pliny's
ption of the stone brought from Mag-
, in Asia, seems to belong to a talcous
ance*.

ffman, Black, and Bergman, contri-
to establish the difference between
esia and lime. It seems originally to
been prepared from nitre; but sea-
' contains the sulphate of magnesia,
t composed of this earth and sulphuric
and which is also found in many
gs, particularly at Epsom, whence it
:alled Epsom salt.

agnesian or talcous earth is infusible
ie strongest heat. It does not form

---

dd, i. 91. It is singular that the modern Italians have also
ita bianca, or white magnet, which is described as fibrous,
bably belongs to the same description. Ferber, Italy 88,
s a white hardened bolus, striated like asbestos.

phosphorets, like the three other alkaline earths, lime, barytes, and strontia.

In talc it sometimes amounts to one half of the composition; but in the other substances, such as steatites and serpentines, it is only from twenty to fo its
power is so great as sensibly to
appearance and qualities of the
chrysolite or peridot of the I
taining about one half magnesia,
this division; and is remarkable as
magnesian gem.

The deserts of Siberia are an
vered with efflorescences of Ep
as in the short summer to resem
The talcous rocks in general pr
criminating character in their
appearance; they have however,
cases, been confounded with t
ceous, which occasionally assu
ness and silky lustre of the m
The presence of magnesia is oft
cated by a green colour.

MODE I. TALC.

this beautiful substance, considered as a Distinctions.
there are two principal structures: the
ɔN talc, which occurs in translucent Common.
, sometimes as large as four or five feet in
ter, and which chiefly comes from the
in mountains of Russia, whence it is called
ɔvy talc; and what may be called MASS- Massive.
lc, consisting of minute scales, irregularly
nerated, as in the substance called the
of Briançon, which, from its farinaceous
position, and other circumstances, cannot
be regarded as a soft steatite, but must
;, on the contrary, to this division. It
at the same time be remarked, that the
ɘncies of all our mineralogic systems, con-
g so common a substance as talc, are not
e surprising. The grave and profound
ɛrius justly confines the appellation of talç
: two substances above mentioned; but the
ɛe has continued to suffer by the confusion
o very distinct branches, petralogy and
ɔgy, every minute substance found in a
or parasitic, disturbing the attention from
rand features of nature. The magnesian

rocks, in particular, have never been d with that attention which their cu importance authorise.

STRUCTURE I. COMMON TALC.

Characters. Texture, finely foliated, and of a glassy appearance; level, undulated, or involved.

Hardness, cretic. Fracture, slaty. amorphous, rather sharp, but the c crumble into white powder.

Weight, pumicose.

Lustre, shining. Translucent, semi-tra sometimes transparent.

The colour is commonly a silvery often also light brown; and speci lour are found, though very rarely, metallic veins, or illinitions. It is a various beautiful tints of green, so able, being reflected as it were thr surface.

Sites. It abounds in the Uralian appears, from the accounts of Gmelin that it sometimes may be said to mountains, while a mountain of quartz one hand, and a mountain of felspar on the so as to present elements of granite scale. Fine talc is also found in t

hence it was brought to Venice, and
rted from that mart assumed the name
ı talc. When calcined into an impal-
Venetian talc.
powder, it was found a far more inno-
for the ladies than bismuth, formerly
vhich is apt to become black, from the
of sulphureous, and some other fumes,
rfumes. An accident of this kind, ope-
terically, as not unusual with the sex,
occasioned the invincible aversion from
ntertained by the Roman females. But
now rarely used, calcined talc is mixed
ne, to form an elegant rouge; which is
h a bit of cotton wool, and rubbed off
ch ease as hair powder.

able account of Chili affords the fol-
Of Chili.
rmation:

ovy glass is there found in the greatest
not only for its colour, but for the size
es which may be obtained. It is gene-
for glazing, and artificial flowers. The
his mineral, which are used for windows,
are here much esteemed, because they
, and less fragile than glass, are often a
gth; and I am convinced they might be
wo feet, if a little more care was taken
rrying. This substance is as white and
t as the best glass; and it has a quality

which seems peculiar to it, that of preve sengers from seeing those within the while these perfectly discern objects second kind of this glass is less esteer though found in plates of a foot sq with yellow, red, green, and blue; quently is not used as the former. called *mica variegata*."*

In the Swiss Alps a beautiful c changeable green, on silvery wl , forming contorted masses, adhering to sian rock. Talc also occurs in leaves sizes, from half an inch to six or in granitic rocks, where it supplies mica. When not larger than m called micarel, genuine mica being the siderous substances. Mr. Kir the name of talcite to a parasitic su the form of small scales, loose, herent.

Chalk of Briançon. The gradation of the involved or c of Swisserland, to the chalk of B Dauphiny, is sufficiently apparent. used by the French tailors in marl on broad cloth, whence the na of c roperly bestowed. The gold and silver nany writers seem rather to be talcous or as the large brown talc sometimes verges den colour, and it is suspected that no und in either.

---

* Molina, Stor. Nat. del Chili, p. 77. The French is very inaccurate.

Iuscovy talc has been used instead of windows and lanterns, especially on ships, where it is not subject to be broken ring of cannon*. It was formerly con- with laminar selenite; and both were *acies Mariæ*, or the ice of the Virgin s the latter is still called by the labourers nartre *pierre de Jesus*, because it served s before little prints of the Saints.

1. *Large foliated talc.* White, from ian mountains.

ish, from Tyrol.

, from the Uralian mountains.

ame, with metallic lines, red, green, and haps from the vicinity of copper-mines.

t 2. *Undulated.* Of various tints, from countries.

---

he *mica membranacea* of Wallerius, which he says was m Archangel.

Aspect 3. Involved or contorted. W St. Gothard.

Of a silvery white, and light gre same.

Aspect 4. Mingled. Foliated plates, forming, with felspar and c large-grained granite.

STRUCTURE II. MASSIVE.

Massive talc, from the Alps of I monly called chalk of Briançon; as lations are never precise, a soft s times sold under that name: but t Fr are not to be so deceived, and the g *de Briançon* may be had from them, broad cloth a farinaceous illinition. It ever at the same time be observed, soft steatite is mingled with micarel, sion will be somewhat similar to tl of Dauphiny. Nay, micarel itself to decompose into steatite*.

The rock of soft scaly steatite, of colour, discovered by Saussure in t

---

* Gmelin, Linn. 69, describes the Cr *tissimè lamellosum*; the soft steatite *particu*

157, appears to belong to this division. It is
ngled with grains of white felspar, and cal-
reous particles, which effervesce with acids.
is so soft as to be almost friable, and splits
o level horizontal layers: this curious rock re-
ses on serpentine, and is surmounted by a mi-
eous lime-slate, strongly impregnated with si-
ous earth.

Dr. Babington has the following varieties*:

" Composed of broad, shining, flexible folia,
sely compacted, and of a greenish white co-
r (Venetian talc), from Zillerthal in the Tyrol.

" This, from being of a white colour when re-
ced to powder, and leaving a beautiful polish
the skin, has long been employed as a cos-
tic. Mr. Hepfner found it to contain mag-
sia 44, silex 50, alumine 6.

" The same, on the surface of semi-transparent
spar, of a pale reddish white colour, and shining
cture, from the same place.

" A polished slab of the same, of a pale green
lour, and intermixed with shining silvery lami-
e, from Scotland.

" Of a slaty texture, and greenish white colour
chistose talc), from Bareuth.

---

* Cat. St. Aubyn, 38.

"The same, of a duller colour, and somewhat more compacted, from Hungary.

"In thin undulating laminæ, of a dark greenish grey colour, from Fahlun, in Swe

"The same, more indurated,
yellowish grey colour, from Zillertl

"The same, of a divergingly
and dark grey colour, from Scot

"Composed of small com
of a white colour and silvery lustre, e
matic crystals of green quartz, from

Karsten, in his catalogue of I
has the following:

"Perfectly *apple green*, mutably
very white, talc, from the Venetian

"Talc, reflecting from the ap
into yellowish, from the same place.

"Massive talc, of coarse and
tinct concretions; and the same,
is mixed with a large quantity of
Ochsenkopf, at Schwarzenburg, in

"A fragment of a talc nodule,
which is very slaty, from Tyrol."

MODE II. TALCOUS SLATE.

Characters.

cture, nearly resembling that of massive
ut easily divides into undulated fragments,
iarter or half an inch in thickness, the feel
extremely unctuous, as that of soft steatite
p-rock.

rdness, cretic. Fracture, foliated. Frag-
, amorphous, blunt, and soft.

ight, carbonose.

stre, glimmering. Faintly translucent on
lges.

e colour is changeable, greenish or reddish,
ed with silvery white. It is found in the
Alps, in Scotland near Portsoy, and in
other primitive regions. Being of recent
vation, it is little known in books of mine-
y. It may perhaps be the laminar steatite
allerius, which he describes as of a grey
r, and found at Norberg, Salberg, and Gar-
erg in Sweden.

Talcous slates of Saussure.

this Mode may also be referred the follow-
ocks, described by Saussure:

The asbestiform steatite rested on a stone,
1 Mr. Struve says had received from Wer-
he name of *chlorite slate.* But the speci-

mens before me are evidently of a c
rock.

"We there see schistose parts of a greenish grey, sparkling, which have the form of small scales of chlorite; but these parts are very refractory, and do not yield the glass of chlorite. They do not form the tenth part of the mass of this rock, in which parts of real steatite, of a greenish white, predominate, soft, translucent, and perfectly characterised.

"We besides find in this stone
lised in little straight plates, rh
rectangular, of a greenish grey, ex
liant, almost of a metallic lustre, a li
than steatite in mass, but with a
These plates lay on one another,
stone glistening spots of an irregu
or four lines in diameter, and
thickness. Viewed with a micros
rated plates appear transparent
but their reduplication renders
translucent in mass. Under the
show themselves very refractory; th
opake, and covered only on their
dark and brilliant amel. I cannot c
but as a species of *rayonnant*, *strahlst*
ner, much like that of § 1437, though
differences.

" As then this schistus results from the assem-
ge of different stones, all of the talcous class,
all it *composite magnesian schistus.*

" § 1917. The collection that Mr. Struve sent
me contains a stone, with a label, which sig-
ies that Mr. Werner had named it an *indis-
ct variety of chlorite slate.* Perhaps in this
tance, as in the former, Mr. Werner assigned
name from specimens different from what I
eived. In fact these are still farther removed
m chlorite.

" The rock before me, and of which I possess
o large pieces, is of a black inclining to green.
fracture is laminar, with plates often undu-
ed, very thin, separable into very fine flakes,
direction of which varies in different parts of
e same piece. This fracture is indifferently
ight, and of a lustre inclining to the unctuous,
well as its touch. It is translucent on its
ges, to the thickness of half a line; the very
e laminæ appear white and colourless: but
ose which are thicker, when looked through,
pear of a beautiful leek green.

" This stone is soft, and may be scratched
en with the nail; the streak being of a whitish
y, but little brilliant. Moistened by the
ath, it exhales a strong earthy smell. Its
cific weight is 2,905.

" Exposed to the blow-pipe, this stone
with difficulty into a greenish grey glass, semi-transparent, which forms a globule, of the tenth of a line at most.

" It has therefore no resemblance with chlorite, and, being obliged to give it a name, I have called it *laminar magnesian schistus*.

" We find enclosed in this stone :
of crystals of the *rayonnant*, or *strahlste*
I have described in the preceding parag
and some detached crystals of octahedral
It is found at Weysler Stoude, in the valley
Urseren."

MODE III. MICAREL SLATE.

Distinctions. This has commonly been confou
mica slate, and has the same gene
ance; the spangles having however
more of the silver lustre, and in other
more of the unctuous cast of talc, t
servable in mica slate, where the n
strongly impregnated with iron. It
the usual adjuncts of talc, and seldom c
garnet, or the other siderous substances, t
found in mica slate. In decomposition, it
times forms plates or illinitions of

ween plates of quartz. It abounds in all the rimitive countries, but has not yet been distinuished from mica slate.

Aspect 1. Micarel slate, from the bed of the anges, near Sirinagur.

The same, from the Alps.

The same, from Scotland.

Aspect 2. Dendritic, from Spain.

MODE IV. STEATITE.

This substance so much resembles fine soap, that in Cornwall, where it abounds, it is commonly called soap-rock.

Characters.

Texture, compact, finely granular, and unctuous.

Hardness, cretic. Fracture, sometimes uneven, sometimes conchoidal. Fragments, amorphous, blunt.

Weight, carbonose.

Lustre, dull, unctuous, sometimes glimmering, with particles of micarel. Translucent on the edges.

The most common colour is white, sometimes delicately streaked with red, so as perfectly to resemble marbled soap. It also occurs ey greenish, and more rarely yellowish, and times dendritic, or spotted*.

Klaproth has analysed the steatite of Co wall, of which he gives the following account:

Of the Lizard. "The steatites of Cornwall (*talcum smectis*, Linn.) occur at the Cape Lizard, in serpentine mountains, which it cuts through in small, perpendicular, or rake veins. The finest sort of it is white, with bluish or reddish spots, r marble. When fresh from the mine it is that, like soap, it may be abraded knife. It is used in making porcelain. T working of these mines is carried on by House of the porcelain-manufacture at cester, which pays £20. sterling for t 20 cwt., because the bringing it out to is extremely uncertain and dangerous, pentine rock breaking in so frequently. T e also occurs in these mines another sort fine, and having spots of iron ochre; a third, brown-red variety, mingled Not far from thence, at *Ruan minor*, also pentine, there is found both a grey-whi r light slate-blue soap-rock, or steatite,

---

* The dendritic occurs in Saxony, and near Kildrummy, land.

vhitish steatite, crossed by calcareous spar,
ich gives it a smooth shining fracture.

" It was the first, finest sort of steatites, that
s the subject of the following analysis."

The result is, silex 48, magnesia 20, argil 14,
yd of iron 1, water 15*.

Da Costa has given more particular inform-
on concerning the soap-rock of Cornwall.

" The soap-earth, or steatites, is found in a
ndy creek, not much above a mile to the north-
st of the Lizard point: the sand is very
ooth and pleasant, of a mixed colour, light
d blue, and when the tide is out, affords many
rning and winding passages betwixt the rocks,
so blue, and the vast masses of cliff, which the
olence of the sea has separated from their mo-
ner land, and from each other. There are also
vo grots, one called Kynas hole, into which
ose sandy walks lead; but in them nothing
markable is to be found, not even marine
ants, it being altogether too often washed by
e tides on the surface of these rocks. There is
rinkled here and there a smooth, fat, and seem-
gly unctuous kind of incrustation, in colour
d feeling much like to the natural appearance
bees'-wax, or tallow, and much of the same

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* Anal. Ess. i. 462.

nature with the white part of the soapy roc but whether it exudes from the crevices rocks, several of which have little cl ks with this heterogenous matter), ca ting what they contain, or whether stance is first washed off by the t veins, and is again returned by t waves, till it incrusts the rocks, ti inquiries only can determine."*

"Most of the stones within reach are covered with an adventitious and tiful enamel; red, white, green, y lucid scales, sometimes riding on different crusts. In the eastern cove, as the Cornish people call it, c substance of the rocks, and the si are more gritty, and being soft, cr of a reddish colour, mixed with v like marble; and the purest, and m lying in veins like metals. It is t ticularly called the soapy rock; unctuousness, smoothness, and greatly resembles the finest kind of s

"The veins of steatites are of breadths; some run under the s the top of the cliff, and some through

---

* Da Costa, 37.

› into the country, and seem in their course to ·oss the tin loads.

" Nearer the Lizard than the soap rock is nother cove called Pintrith, which affords a ·reyish impure steatites, spotted with black.

" The new soap rock, lately discovered, is at ›ew Grez, or Grez cove, in the tenement of ·ynas, in Mullion parish: it is about three niles from Mullion town, and about a mile from he old soap rock, or cove, which lies farther outhward. The entrance into the creek or cove is very steep, craggy, and horrid: on the right hand (in descending into the creek) the hills are crested with naked rocks, or cairns, as the Cornish people call them: the sides have also many, but they are small. About half way down the cove, a very small current of water traverses it, in a very serpentine manner, and discharges itself near the load, or principal vein of the steatites. On the right hand, as you descend the cove, it grows more craggy and much narrower; and a few yards lower, on the same side, lies the main vein or load of steatites. The various sorts are all blended together in spots, sometimes in greater quantities in one place than in another. In the white and red veined steatites, pieces of a compact, hard, slightly pellucid, sparry substance, are frequently found:

the main vein, or load, is about eight feet it does not consist purely of the steat also holds quantities of rubble, or f a hard, smooth, dusky, greenish, n loured talcy-like fissile stone, called habitants a variegated killas. Some pieces of white spar are also met with, y. About two hundred paces higher, hand, I found a soft and very gr coloured steatites: in the sides of t ry, that is, of the solid strata which e vein, and intermixed with it, lay a redd steatites, but the straw-coloured kind n greatest quantity: further down, near t of the sea, the steatites load has been larly traced, and makes a course of teen inches wide between regular sides: hand side of the cove is quite per and consists of a hard black stone, divided into strata by small horiz placed at great distances from each er. other sides of the cove are more open a the sea beats strongly into the creek, low water has a small sandy beach."*

Of this substance there are two very structures; the soft, already mentioned,

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* Da Costa, 37.

To the last the following interesting ob-
ions of Patrin chiefly refer; and they are
iore freely extracted, because his works,
hose of Saussure, though of the greatest
tance to the science, have never been
ited, and remain new to the mere English
.

Patrin's account.

'here is often so little difference between
and steatite, that Saussure, who was so
acquainted with rocks, sometimes uses
two denominations in speaking of the

Steatite and ollite.

substance; or, at least, he calls steatite
bstance which forms the base or the paste
te. The greatest, or the only difference
, in fact, exists between them is, that
e is a more simple and more homogenous
ound, and that it is also more unctuous,
ollite.

t may be said, that steatite is to the ol-
'hat *cornéenne* is to porphyries. It is a
which contains crystals, or, at least, dis-
particles, of mica, talc, sometimes of as-
or amianthus; as the base of porphyries
ns crystals of felspar, schorl, and grains of
:. Steatite is even observed, as that of the
it of Roth-horn, near Mount Rosa, which
ns grains of felspar; and this mixture also
ollite.

“ A steatite is found in Corsica, whi solid, of an even tissue, of a uniform olive-g colour, semi-transparent and unctuous: it what the Germans call nephritic stone, on count of its resemblance to the jad of the r of Amazons, which has that name by exc lence. This steatite is, with a slight difference of colour, exactly like the lard-stone of China.

“ Saussure gives the description of a steatite of St. Gothard, which he calls asbestiform steatite: it is very interesting, because it shows transition of one stone to another.

“ It is of a grey, approaching to y green, and it much resembles asbestos, fibres are much larger, softer, and m tuous. Its longitudinal fracture sh fibres, parallel to one another, irre rly matic, as much as three inches long: t tre middling, sometimes bright; but to a bed of talc, which covers the f stone.

“ Its transverse-fracture is uneven, translucent on its edges: soft, and scratc the nail. The small fragments melt blow-pipe into a black globule.

“ It is then evidently, Saussure says, intermediate between talc, steatite, and

“ Romè de l'Isle mentions a greenish st ite

Corsica, crystallised in hexagonal plates, aced horizontally; and which are only, he ys, distinguishable from mica as they are aller, and are oily and unctuous.

"I have similar crystals, which are found in-id in topazes and emeralds of Siberia; and as perceive the insensible transitions from pure ica to this unctuous mica, I look upon this st as a simple modification, or perhaps the ommencement of the decomposition of the real ica.

"Saussure has observed on Mount Cervin, ear Mount Rosa, a steatite which he has called pecular. It terminates the last rock before the now. He has given it that name because its urface is as smooth as a mirror, and as polished s this species of rock admits. Its colour is a ery dark bottle-green; its fracture irregularly histose; it is soft, and is easily scratched with grey streak*.

"Saussure has elsewhere seen, and particu-rly near the convent of Mount St. Bernard, a rge rock of a quartzy nature, whose entire rface is polished so as one may see one's self it, as in a looking-glass. He justly regards is phenomenon as an effect of crystallisation.

---

* See Sauss. § 2258.

“ I have found in the lead-mine
of Kadaïnsk, in Daouria, near the r
steatite of a very remarkable
of a tolerable firmness, it is
drawing the finger along its sur
the same gloss as it would to
It is of a perfectly homoge s
composed of very distinct
half a line to a line in thi
are of a beautiful milk wh ,
an ochre yellow. These layers,
torted, are parallel among th
generally presents seg s
cles, the stone has the ap
wood.

“ I had brought away two s
wished to wash one of them; but
wet before it broke into little f
of a pea, all the fractures of
fectly conchoidal, and the an
The mark of the layers has al
appeared in these fragmen
sumed a uniform tint, between
The thinnest fragments are tr
edges.”*

This stone must resemble the
described and figured by Wallerius.

---

[*] Patrin Min. i. 195.

fter steatite chiefly occurs in veins in e, and in nodules in basaltin* and e: but the harder forms rocky masses, ubstance could not have appeared with in the present treatise. The rock of tite, described by Saussure, may serve mple: he discovered it on his journey Nice and Genoa, on the sea-shore, of t of 15 or 20 feet. The exterior surface : here reddish, there of a silvery hue, r soft to the touch.

Rock of steatite.

lits in irregular fragments, rather ap- to the rhomboidal. Its fracture is irregular, and otherwise very like its urface: it gives a grey streak; is soft, er heavy; odour earthy; easily melts ey glass, which sinks on the support; effect on the magnet.

rock composed of this stone is divided of spar and quartz; and this last con- places, pieces of green hornblende.

e parts of this rock are of a bright deep- olet colour. The fracture presents schis- inæ, irregular, small, and often con- the streak is of a reddish grey; like

---

ecimens of this kind are brought from the isle of Rach- north of Ireland, celebrated as the retreat of Robert I. land from the English power.

the other, it is soft, rather heavy, and very
ble, but its glass is black, while that of t
is grey; it is doubtless a superabur
which gives these pieces their red
causes their glass to be black; but
under the form of oxyd, or what
for neither does this stone affect tl

"This rock is succeeded by
and of the same nature, on which s
chapel, dedicated to St. Andrew,
it the name of *Scoglio di St. Andrea.*

"This rock stretches along the
afterwards covered by a grai
similar to that of La Garde, § 134
that, splits in small polyhedral fi
gular, the faces coloured by ferru
cences, and which falls like it in
This same stone is still seen in tl
Peggi."*

STRUCTURE I. SOFT STEATITE.

White soap-rock, from Cornwall.

The same, mottled with red or blue,
same country.

The same, rather harder, from Portsoy,
land.

---

* Sauss. § 1357.

same, with elegant variegations of red.

same, greenish, in serpentine.

te steatite, with black dendrites, from Sax-

ten mentions a massive steatite, which is n extensive strata at Thierschein; but he t distinguish between the soft and the hard

atite, crystallised in hexahedral prisms of a g size, terminated by six planes, the edges by the meeting of the lateral and acumi- planes, truncated, but in other respects cir- ced as usual, in massive steatite, from e place."†

teatite, called Spanish chalk, but probably Alps of Dauphiny.

steatite, from New Caledonia, where the mix it with their food. This custom is wn to the savages on the Orinoco; nor nown in the German country of Lusatia. abs are said to use it in their baths instead and it is also used as fullers' earth.

ite, in basalt, from Skey, and other western Scotland.

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* Leske, 131. † Ibid.

STRUCTURE II. HARD STEATITE.

Distinctions. Soft steatite may be scratched with
but when the coherence is such that tl
does not yield to the knife of c er,
sometimes of steel, it must assur
hard steatite; the hardness exte
gypsic to the marmoric, and even to
It must here be premised that the
idols, formerly supposed to be of
ite, are now known by chemical analy
entirely to the Argillaceous D
among many others, of the insuf
nal characters, and that mineralogy
certain light, except from the lamp

Aspect 1. Compact. Hard stea
ing to serpentine, of a dark green
chlorite, from Silesia.

Of a pale green, with black lines,
of Dauphiny.

The early writers sometimes c
steatite with ollite.

Aspect 2. Laminar. The plates
monly curved, and occasionally
fracture. It is translucent on t

etimes entirely. Mr. Kirwan calls it foliated,
striated steatite; and says that it is generally
nd in independent amorphous masses, some-
es investing or intersecting serpentine.

' Leek green, inclining to olive green, curved
ated steatite, from Norway.*

' Mountain green, partially sprinkled with
:k, foliated steatite, from Zöbliz."†

MODE V. OLLITE.

Characters.

Texture, earthy, rather schistose.

Hardness, cretic or gypsic. Fracture, un-
n, somewhat slaty. Fragments, amorphous,
nt, often laminar.

Weight, carbonose, sometimes granitose.

Lustre, dull, sometimes glimmering, unctuous.
ake; if translucent on the edges it approaches
hard steatite.

The colour is often greenish grey, or blackish
een; sometimes yellowish, or reddish. It is
en spotted, like a snake, whence the ophites
the ancients, which certainly belonged to this
ıd, and not to the green porphyries, as has
herto been supposed by a long train of mi-
ralogists, copying each other. It differs from

---

* Leske, 131. † Ib.

serpentine, by the grain being finer and fatter; and is more easily cut with a knife.

That of Chiavenna has been
Weigleb, who found, magnesia
argil 6, iron 15. Who would supp
analysis, that Werner should p
stance among the argillaceous,
contempt for chemical principles,
alone afford any solid foundation for
as when he places the corindon gems
the siliceous, though they do not contain
atom of silex! The paternal love of l
system must be violent indeed, w n
such contempt of every principle
science has been founded.

This substance has commonly
lapis ollaris, which has been translated
from the use to which it has been
Ancient. from remote antiquity, Pliny r nti
the stone of the isle of Siphnus, in t
Archipelago, and the greenish stone
in Italy, were both used in his ti
vessels for cooking food. Wad, in
of the Borgian museum, mentions sev
tian monuments of ollite, chiefly s
The varieties are:

Ollite, of a blackish green, with grass green spots.

lite, of a yellowish green.

an olive green, with larger and smaller of a greyish black, spots of a liver brown, mall specks of an Isabella yellow.

an olive green, with grass-green spots.

mi-transparent, of an emerald green, with lar oblong spots of an ochre yellow. This d rather seem to be a hard steatite.

a greenish grey, with a cast of blue.

a yellowish grey, verging on Isabella co-

a foliated structure, resembling, as he adds, minar steatite of Karsten.

o other relics are of a brownish black, and enish black; in a third, mingled with a few green spots.

e learned author has added the following vations:

Thebaic stone.

To this class, which affords so many Egyp- remains in the Borgian museum, belongs Thebaic stone of the ancients, which con- ted large portions of mountains, the quar- being mentioned by Theophrastus. Pliny bserved that it was black, or of a dark co- and marked with golden spots *. He observes that it yielded a juice, whence

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* xxxvi. 8, 22.

it must have been soft, and was used f
tars, as, from its natural benignity, it
peculiarly fitted for pounding medici Il
compare these indications with any l
stone, we shall find they agree with tl ,
the colour being frequently black t, i
sometimes spotted with golden mi
nature, and used for mortars, one of
being of that description."

It has already been mentioned in
tion of green porphyry, that the T io
of Lucan, and the dark ophite of iny,
spotted ollites, which in fact
semblance to the skin of a snake tl
phyry, to which the appellation l
lessly transferred.

Boot's ophite.

Boot, physician to the emperor I.
1576—1612, published a treatise
stones, certainly very able and
period, for he was the first who,
the diamond (lib. ii. c. 1. p. 117.
8vo.), remarked that it belongs to
mable substances; an idea also, u
ferent and original grounds, ado
great Newton. This author, af
oscorides and Pliny, observes t
a grey stone, found at Zoblitz, a
making pots or vases, and the re

cal qualities continued to his day. The s of Zoblitz in Saxony are still well known. et, in his treatise on Gems, 1647, 8vo. 8, rather confuses the question, as usual commentators, but quotes Gesner, who s the fountain of the error, that ophite is a marble, or porphyry, owing to his merely ng one sentence of Pliny, without adding ubsequent context. Laet says, that he re-d from Crusius a fragment upon which he written, "A fragment of the cup of Ed- IV. King of England, formed of the stone d ophites, useful against poison, the gift of organ, 1581." This fragment was of a dull colour, very little translucent, sprinkled crystalline spots of a bright green, and y conspicuous if held before the light. This have been a serpentine, or ollite, with hex-al spots of green mica, or steatite. The eous application of the term ophite by the test mineralogists, for more than a century, excuse even a repeated confutation.

Ophite of Edward IV.

he ollite of Como, which is still in use, is of liated texture, and greenish grey colour. t of Saxony, used for tea-caddies, milk-pots, several other purposes, is of a greenish grey, irregular veins and spots of black. The e house of Inverary, the seat of the duke of

Sites.

Argyle, is constructed with a dark ollite, of which there are quarries in the neighbourhood; and which has likewise been formed into punch-bowls and vases. It is also said that the cathedral of Bergen, in Norway, is built of ollite.

In the middle ages, Chiavenna had supplanted Como in this article of commerce, the quarries of ollite being at Pleurs, a town about two miles to the north-east; but the excavations were conducted with such little care, that in 1618 the hill fell down, and buried the city, with the greater part of the inhabitants*. Near Oletta, in Corsica, ollite is found of a bright olive green, and is worked by the lath like the others. Roziere, in his interesting memoir on the valley of Cosseir, in Egypt, mentions that the Arabs make little vases of an ollite, which they find in that country. The celebrated calumet†, or pipe of peace, of the American savages, is of a greenish grey ollite, with reddish veins and spots, and is cut with the knife into a not inelegant form, with a second cavity adapted to receive a long reed, which serves for what is called the stem. On the west of the Missouri the savages are said to use a red serpentine for the same purpose.

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* See the affecting detail of this event in Burnet's travels.

† So called from the French *chalumeau*.

is the culinary use of ollite unknown among
: rude tribes.

reenish grey ollite, spotted with golden mi-
'rom Egypt.

he same, spotted with green scales, from the
:.

ie same, spotted with black, from the same.

iese varieties belong to the real ophites of
incients.

reenish grey ollite, with black veins and
, from Zoblitz, in Saxony.

:llowish, from the same.

ght grey, from the same.

ie same, from Como.

:llow and green ollite, from Finland.

irsten has the following specimens:

Greenish white, reflecting changeably into
ry white, pot-stone, from Ochsenkopf.

Greenish grey, spotted with reddish, pot-
:, from the same place.

Very thin slaty pot-stone, with inlaying
iets, from Tyrol.

Thin and curved slaty pot-stone, mixed
quartz, from the same place.

Very thick and curved slaty pot-stone, from
senkopf."

iese examples are rather singular, and the first may possibly be the white ophite of Pliny*.

Ollite, in rude pots, &c. from the extreme northern regions of America.

The same, formed into the heads of calumets, or pipes of peace, from North America.

MODE VI. SERPENTINE.

Characters. Texture, small-grained, compact.

Hardness, marmoric. Fracture,
even, sometimes scaly, sometimes
choidal. Fragments, amorphous, rat

Weight, granitose, sometimes sider

Lustre, dull, sometimes rather gli
Opake; often faintly translucent on t

The colours of this noble rock are
rich and various. They are thus e
by Mr. Jameson:

"Its principal colour is green, of which it
presents the following varieties: leek, , and
olive green; from oil green it passes
tain green, and greenish grey; fr

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* Saussure says, § 1724, that near Zumloch,
there is a quarry of ollite, the stone being c
translucent talc, grey mica, little pyrites of a
times iridescent, and a little lime.

to greenish black; from greenish
ies into blackish green; sometimes
llow, and rarely yellowish brown:
of which it presents the following
ood red, brownish red, peach-blos-
scarlet red.

ich-blossom, and scarlet red colour,
t.

our is seldom uniform; there are
eral colours together, and these are
striped, dotted, and clouded deline-

Primitive.

mitive rock, and appears to be stra-
ike granite, very indistinctly. It is
it geological observation, that some
cularly the calcareous, assume the
of being stratified, by incipient de-
, as Ramond remarked in the Py-
t may not even this circumstance
d as a proof of original stratification,
ered more apparent by the decay of
arts; as, if there were no original
e humidity to enter, the decompo-
only occasion irregular crevices?

nd his disciples have observed near
between the formations of trap or
l serpentine. When the former con-
cess of magnesia, it becomes a re-

markable *pierre de corne* of Saussure, here Saussurite, in honour of that great observer.

Patrin is perhaps the only professed wri mineralogy who has enlivened his subje variety of illustration; and as his work bably never appear in the English language, his descriptions, which often contain anecdotes derived from his own extensive travels, are given with the less hesitation.

Patrin's account.

"Serpentine owes its name to its colour; it is generally green, often spotted with white, yellowish, brown, and sometimes reddish marks; which gives it some resemblance to the skin of serpents. Its green colour is owing to iron; which is abundant in it, and but little oxygi-nated*.

"It is generally opake; but some of are occasionally semi-transparent. T very hard, it receives a fine polish, unctuous appearance, like jad.

"Serpentine is a primitive rock; tion has been a little posterior to t granite, for it is very rare to find t It has been contemporary with that of m and calcareous schisti, with which it times seen confounded, whether in t

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[*] This seems rather doubtful.

inct beds, but which alternate, and are)cally overlaid, the one on the other.

:rpentine is rather more abundant in na- ıan traps and *cornéennes;* and much more n porphyries.

is generally found in amorphous masses, orphyries, and seldom in distinct beds. ıs chains of hills or mountains, but little ɜd, at the foot of great granitic chains: it ɾ rare to find it in very lofty mountains, ill more rare to see it form beds (arrects) ıching a vertical position, a position so on to micaceous schisti.

ı regard to the little elevation at which tine is generally found, there is an excep-)erhaps unique and very remarkable, in t Rosa, where there are summits which Mount Rosa. .nd the central part of that mountain, are composed of serpentine, although :levation is from 1500 to 1700 fathoms, and ·ds; and what is also very remarkable, is, he beds of this rock are there in a position often horizontal. But even this position, ıe presence of serpentine at this great ele- , are owing to the same cause, which I explain in treating of geology; for this tain, become famous since the travels of ıre to that region, and which is one of the most extraordinary existing, is also one of th which will throw the greatest light on the tery of the formation of primitive mount .

“ Europe is that part of the terrestrial g in which most serpentine is found; the w front of the Alps, which looks towards *Italy*, offers it almost every where, although these mountains show but very little of it towards Swisserland.

“ It extends throughout Italy, where called *gabbro*. One of the finest is that hills of Impruneta, near Florence: it c good deal of that green, semi-t satiny substance, which Saussure smaragdite, on account of its fine c rald green.

“ France has some mountains of especially in Limousin.

“ The finest serpentines of Sierra-Nevada, two leagues from Gr have a green base, filled with glis of a yellowish colour. Superb c been made from it, which decorate t and palaces of Madrid.

“ It is almost entirely wanti Asia, with the exception of the n the Ural mountains, which from Europe. There are some lls tervals, accompany their base, following rection from north to south. There are [illegible] detached branches, which appear bolsk, which is not far from those moun- [illegible]

t from thence to the river Amur, that is in a space of about a thousand leagues; y any vestiges are found, in the great of Altai, Sayannes, and in the mountains uria.

e serpentines most known are those of g, in Sweden, and of Zeoblitz, in Saxony, ich vases are turned of every kind, which ad over Europe*.

e serpentine of Bareith is filled with gar- an irregular form, generally of the size of they are sprinkled in an equal manner mass, and when the stone is polished it s a very agreeable mixture of spots, of a l on a green base. Trinkets and other nts are made of it.

assure has observed several serpentines, in locks, on the shores of the lake of Ge- hey are remarkable by their specific gra- hich is greater than that of all other ser- s. He saw some soft, and some hard.

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[*] It is commonly an ollite.

The softest is foliated, and its specific weight exceeds 3000, which is the weight of oriental jad. It is this softest variety which the best resists the action of fire.

" Some of the blocks found in the valley of Chamouni present a green serpentine, marbled with white, like the serpentine of Saxony; others, a green serpentine also, but mixed with shining plates of green talc, threads of asbestos, and of brilliant and golden amianthus, with laminar crystals in the form of flattened parallelopipeds. These crystals have neither the hardness of schorl, nor the characteristics of hornblende; they melt into a white amel, while hornblende always gives a black glass. The plates of green talc are infusible; and the serpentine which constitutes the base of the stone melts, in bubbling and emitting little sparks.

" These fragments proceed fr
considerable masses, which have
by time. Saussure saw, near Chiav
country of the Grisons, entire moun
pentine and ollite, which were only
coherent blocks.

" The summit of the mountain of
Genoa, is composed of a serpenti
sure has called granular: it is of a
green, with unequal fracture, dull,

ain argillaceous smell, and melting under
r-pipe into a black glass. Its exterior
ed with a coat of rust.

e observation of the characters of this
mportant, as it shows the transition of
nes to *cornéennes*. It is absolutely mid-
ween these two sorts of rocks.

r beds of this serpentine alternate in the
in with beds of calcareous, quartzy, and
ous schistus; and with beds of primitive

Roth Horn.

e mountain called Roth Horn, or Red
nd which faces Mount Rosa, towards
elevated 1506 fathoms: it is composed
pact serpentine, divided into irregular
of an immense size. The surface of this
ne becomes red by the action of the
here, which oxyginates the iron it con-
the highest degree. It is this colour,
elongated form of this mountain, which
ocured it the name of the Red Horn.

is serpentine is covered by a steatite, of
reen colour, mixed with carbonate of
nd grains of felspar. On this steatite
calcareous micaceous schistus repose, in
he mica contained is more than one half.
schisti are again covered by serpentine:
beds are nearly horizontal, a little raised

towards Mount Rosa. Geologists will perceive the importance of this observation.

Mount Cervin.

"Mount Cervin, another mountain near Mount Rosa, is an inaccessible obelisk, of a triangular form, which is elevated to the prodigious height of 2309 fathoms above the sea, according to the trigonometrical measurement, taken with the greatest exactness, by Saussure. It is composed of three distinct masses, piled the one on the other.

"That which forms the summit is of
Isabella colour. It is composed of
mixed with micaceous schistus, cal
quartzy. Saussure has thus judged
struction from other neighbouring
which he has visited, and which pr
the same colour.

"The mass which is under this
colour, and formed of gneiss and q
ceous schistus. Saussure saw some
ments.

"The third exactly resembles t
Saussure found that it is also of ser
ternating with calcareous micaceous

"The base of the pyramid is of
but of a confused structure.

"I repeat, that mountains of serp
seldom of a great elevation; and t

ut Mount Rosa are owing to a peculiar and al circumstance.

Magnetic hill.

' One of the most remarkable hills of serpen- e, on account of the phenomena which it pre- ts, is that observed by Humboldt, in 1793, in chain of mountains which separates the mar- viate of Bareith from the Upper Palatinate.

' This hill is only elevated fifty fathoms above neighbouring plains: it extends in length n east to west, its skirts consequently are to north and south.

' The rocks which crown its summit are of a pure serpentine, which, by its colour and ated fracture, approaches schistose chlorite. divided into tolerably distinct beds, and re- s on a veined granite, mixed with horn- nde.

' Humboldt having brought his compass near se rocks of serpentine, saw with surprise, that north pole flew round quickly to the south. farther observed, that the rocks of the north clivity, and those of the southern, have their les directly contrary. In the former are only nd south poles, and in the latter north poles. e eastern and western extremities of the hill in a state of indifference, and do not mani- any action on the magnetic needle, though erwise the rock affords the same appearance.

" In the magnetic parts of this hill
rocks are also observed, which have
by the side of similar rocks, which
strong one. Some affect the nee
tance of 22 feet.

" This mountain not only exerts
the magnetic needle in its whole n
other mountains, but it is manifest
small pieces. Humboldt has observed,
ments, scarcely visible, are briskly moved,
presenting to them, one after the other,
of the weakest magnet: and it is r
that a substance possessing such
larity, has not the least attraction
magnetised.

" Humboldt convinced himself tl
pentine does not contain an atom of
iron; all which it contains, and wh
it, is in the state of oxyd. It is
to explain the cause of so remarl
menon.

" The specific gravity of this
much less than that of others; it o
from 1900 to 2000, while the ordi
of this rock is 2700, and even reac
sure has observed, to 3000, in certain
which he found in the vicinity of the
Geneva.

Chenevix, the chemist, who has em-
imself in a succession of analyses, of
rocks, found that serpentine and ol-
mposed of the same elements; and
ording to a medial sum of many ana-
y contain, silex 28, argil 23, magnesia
of iron 4, water 11."*

Name.

ame serpentine seems to have been de-
m the Italians, who however applied it
ently to several substances; as black
r was called *serpentino nero*, and the
rphyry *serpentino antico*†. The name,
as vague at first, was afterwards con-
his magnesian rock, to which it is most
applicable, from the variegation and
appearance of the colours.

Italian.

has minutely described several of the
erpentines, particularly that of Impru-
ar Florence. The colours are white,
k, yellow, and green; sometimes uni-
metimes intermingled. It is often inter-
y small veins of asbestos, and sprinkled
unctuous micarel, of a greenish silvery

Min. i. 177.

i. 432. It is singular that this truly learned author
followed the common error concerning the ophites of

hue, of a square form, and not hexagonal, like mica. There are also perpendicular veins, from six to twelve inches in breadth, containing the following substances: 1. Farinaceous steatite, or soap earth, white and green. 2. *Chalk of* Briançon. 3. Fibrous steatite, passing to asbestos. 4. Asbestos. 5. White and green amianthus. As he wrote in 1772, in the mere dawn of genuine mineralogy, his names are modified by his descriptions.

Useful in the arts.

As serpentine, like ollite, resists fire, it would be found of far more utility in domestic and public monuments than marble; yet its use has been unaccountably neglected, both in ancient and modern times. The beautiful serpentines of Portsoy, the singular white-veined marbles of Durness, and the most elegant of all the marbles, that of Tirey, with the fine green serpentine marble of Anglesea, might supply the British empire with decorations far exceeding the fashionable imports from Italy, the insipid marbles of Carrara and Sienna, especially a period when we should only enrich our enei

Nephritic stone.

Serpentine, like the other mag impressed the ancients not irratio ly idea of medical qualities. Internally they act as absorbents; but the nephritic sto osed, when only worn, to cure diseases of reins, or the lumbago*. This nephritic e is often found in flat pebbles on the shores e sacred island Hyona, among the Hebudes cotland. It approaches to what is called the *giada* of the Italians, and is also found Jad. e island itself, adjacent to fine white mar- As jad however has never been yet ob- ed to constitute a rock, but, according to imperfect observations, has only been found vers in schistose fragments, whence it would only to form thin layers, it has not been itted into the present work. It must also bserved, that the analyses hitherto given of substance are not satisfactory. The jad, h forms the base of the composite rock d the Corsican green, has been pronounced Werner to be a felsite, or compact felspar; if the analysis of the younger Saussure be ed, it contains no magnesia. It may seem e nearly the same substance with the iconite e Chinese, only in a far higher state of in- ation. This substance has also, by some ers, been called *lemanite*, from the *Lacus anus*, or Leman Lake, now called the Lake

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[*] ccording to others, the stone, or gravel; in which sense it is y modern physicians. See Johnson.

of Geneva, upon whose shores it
Saussure.

Werner and his disciples have c
ancient name of nephrite to jad,
class among the magnesian rocks;
vide it into two sub-species; the
is brought from China and the East*,
they call *beilstein*, or axe-stone,
brought in the form of axes from
rica, whence it might strictly be
dental. It is to be regretted that
mist, no Klaproth nor Vauquelin,
the various kinds of jad, though
brated beauty and utility; it r
certain, whether it ought to be r
magnesian, the argillaceous, or wh
not even be an unctuous keralite,
unctuous quartz. It may perh
various kinds and compositions,
be distinguished by new appellat
French writers have called it *fel*
jadien†, which, they add, is the

---

[*] Wad, p. 23, mentions different monume of
which one of a leek green, which, he adds, is g
with Persepolitan characters. Roziere brought f
ment of red granite, marked with the same k
ment which, if I remember right, he discovered in the

[†] Brard, 166.

ies, and the nephrite of the Germans; only
erent from other compact felspar by its tena-
r, weight, and unctuous appearance, while it
lts under the blow-pipe like other felspars.
e able and ingenious Haüy has added the
anite, or white jad, as an appendix to fel-
r, under the name of *felspath tenace*; while
anks jad, the nephrite of Werner, among the
stances whose characters are not sufficiently
wn to find a place in the system. He re-
ds the axe-stone as totally different from the
ntal jad, of which he gives two analyses, one
the younger Saussure, who found iron, man-
ese, soda, pot-ash, &c. &c. and has acquired
e reputation as a chemist. Karsten, in his
les of mineralogy, Berlin 1808, has given
ther, by Kastner, which is probably authen-
and deserves repetition; silex 50, magnesia
argil 10, water 3, oxyd of iron 5, with a tint
hrome.

Asbestos.
Amianthus.

Mineralogists having in general supposed that
or nephrite occurs in veins or layers in ser-
ntine rocks, it was proper some account should
given of so remarkable a substance. For the
e reason, it may be proper here to mention
estos and amianthus, almost constant in the
lst of serpentine, but which cannot be regarded
orming rocks. The late ingenious Dr. Walker,

professor of mineralogy in the University
Edinburgh, who repeatedly visited the W
Isles of Scotland, is said to have l,
the little isle of Bernera, which te
exterior chain of the Hebudes, is f
amianthus, or, as he more probably a
mixture of asbestos and amianth
forth, the excellent proprietor of
regions, and himself a mineral
sulted by the author, answered, t
a circumstance was unknown to
could scarcely have escaped his
The finest amianthus occurs in C
beautiful white silky threads, of t
in length; and it is so abundant,
used it instead of flax to pack l
There is also a mountain in the Ura
which is called the Silky Moun n,
sures of a Saussurite or magnesian
is found an amianthus, which at
compact and hard, but when ex
for some months, it swells, and
down, as flexible as cotton*. But e
scarcely be said to form a consti
the mountain, and amianthus on
is frequent in rocks of this descri

---

* Patrin, i. 216.

ıust continue to be regarded as a parasitic ıstance: and if even a rock or hill consisting ely of asbestos and amianthus were discover- , it must be classed among the anomalous, as ng contrary to the usual course of nature.

Having thus discussed the chief parasitic sub- ıces which are found in serpentine, it is pro- to return to the immediate consideration of t celebrated rock.

Noble serpentine.

Werner and his disciples divide it into two of ir barbarous *sub-species*, under the epithets mmon and Noble; the latter being trans- 'ent, and chiefly found in Silesia. It is gene- y of a dark leek green, and of an unctuous ıge. Mr. Jameson says that in Italy it is led nephrite, with which it might perhaps be ssed. But when Brochant supposes that the *de antico*, and other green marbles well known Italy, belong to the noble serpentine, he for- s that they are all opake, while the latter is nslucent. When he quotes Estner, who con- ınds the *verde antico* and ophite with green rphyry, the confusion is infinite; for the *verde 'ico* is a marble, which will presently be de- ibed; and the ophites, as already shown, is a re error, echoed by mineralogists for a cen- y and a half, while the ophites of Pliny is an te. The noble serpentine of Werner, which is found in small masses or dissemi rather to belong to lithology or gemmology.

STRUCTURE I. ENTIRE.

Black serpentine, from Egypt.

Brownish serpentine, from the same. These are small statues, described by Wad.

Serpentine, with white spots, from Cecina, near Volterra, Tuscany.

Black, from Monte Ferrato-di-Prato, call *Nero-di-Prato.*

Green, from the same, *Verde-di-Prato.*

Gabbro, or serpentine of various colours, from Impruneta, seven miles south from Florence.

Green serpentine, with yellow spots, from the Sierra Nevada, in Spain.

Serpentine, shaded with various from the Pyrenees*.

Deep green magnetic serpentine,

Green serpentine, marbled with Vale of Chamouni.

Serpentines, from Corsica and Italy.

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* The erroneous ophite of Palassou, whose work on nees has great merit. See his prolix dissertation on thi ophite, Journ. des Mines, v. 31. He is however nearer than Gesner, and his successors, who supposed ophite porphyry.

Brown serpentine, spotted with red, from the zard point.

Dark green serpentine, from the same: perhaps e name of the cape is derived from the colour.

Serpentine, of various colours, from Portsoy.

Yellowish serpentine, from Zoblitz, in Saxony.

Black serpentine, spotted with red, from the me.

Green serpentine, in pebbles, from the Lake of eneva.

Granular serpentine, from the Alps.

Serpentine, from the mountain of Cervin.

STRUCTURE II. MINGLED.

With mica, from the Lizard point, &c.

With veins of steatite, from Cornwall, Portsoy.

With asbestos, from the same.

With amianthus, from Zoblitz.

With foliated steatite, amianthus, and garnets, om the same.

With garnets, from Bohemia.

With asbestos and calcareous spar, from Prato.

With spangles of satiny diallage, the smaragdite f Saussure, from Impruneta.

With metallic diallage, from Saxony.

With the same and epidote, from Queyras, near riançon.

Saussure presents some un
Serpentine, with spots appr ir
lisation: may not this be
Pliny as gemmose? § 107.

Laminar serpentine, of a yell
striated surfaces, and translucent
§ 2253.

He also describes, § 1434, another granular serpentine, with an earthy fracture.

Mount Cervin rises to a pr s
der the form of a triangular
which seems hewn with a chisel:
is alike singular and mag
§ 2220, gives a curious account
mountain of serpentine.

MODE VII. SAUSSURITE.

Characters. Texture, fine-grained, comp t.

Hardness, basaltic. Fracture,
and earthy, sometimes scaly.
phous, rather blunt.

Weight, granitose.

Lustre, dull, sometimes
from particles of siderite. O

Colour, black or dark grey, s

ng towards the green, from an excess of
esia.

is stone may be regarded as intermediate
een basaltin and serpentine, and might be
l magnesian basaltin; but as it is the most
rkable *pierre de corne* of Saussure, it has
thought proper to give the name of that
observer to this important rock.

Cornéenne.

e *pierre de corne*, or *cornéenne*, is a vague
llation, still retained by the French mine-
ists. It sometimes implies a trap, some-
a wacken, sometimes an earthy siderite;
ometimes more appropriately the present
Saussure has observed, § 1225, that when
ornéenne appears crystallised, it assumes
ame of hornblende. He has given, § 725,
ialysis of his *pierre de corne*, and observes,
he chief difference between it and basalt
: mixture of magnesia. In Kennedy's ac-
e analysis of basalt there is no trace of
esia; but in the Saussurite there ought to
ore than 6 in the 100. The decomposition
e iron often forms a kind of bark around
tone, whence it has been called by some
rs *pierre-à-ecorce*.

lomieu, in his celebrated memoir on felsite
ap, which precedes his distribution of vol-
products, observes, that the cavities in

trap are commonly filled with calcare while those of his *roche-de-corne*, or besides calcareous spar, often pr

With steatite.

steatite extremely ferruginous *. T with the occurrence of amiantl modes of talc, confirms the n sity of this rock; and as the g are also frequent in amygdalite, it pected that the latter, to the l rious denominations have been when duly analysed, be found to division.

Dolomieu also considers the c Werner, which often presents oc of iron, as intermediate, between *corne* and the talcs; while the former from trap to serpentine.

" In Tuscany there are freque these passages of *roche de corne* At Pietra Mala, on the ridge of t to the right of the road from rence, there is a mountain which the kinds of gradations between *roche de corne*, and the passage of grain of this to the scaly texture of or *corneus spathosus*. This *roche de*

---

* Journal de Physique, 1794, p. 268.

ɔase, marked with white and green spots,
en taken for a lava by many naturalists,
others by Mr. Ferber."*

t the *cornéenne* is a term which ought to
nissed from mineralogy, will sufficiently
from the following description, by Brong-
ı very industrious and exact mineralogist.

ɔrnéenne† is a rock very difficult to deter-
and still more difficult to confine to pre-
mits. On one side it approaches very
wacken, and on the other to argillaceous
s: it has besides numerous relations with
and even with *amphibole*, or hornblende.
ıis rock is generally compact and solid;
ture is dull, rather even, but irregular; it
by breathing on it a very sensible argil-
s odour; it is generally difficult to break,
g the hammer to rebound, and presenting
of tenacity, which throws it at a distance
racken, and approaches basalt. It often

---

rnal de Physique, 1794, p. 258.

orneus. Wall. This genus contains the greater part of our
'e hornblendes. *Cornéenne* rock, Haüy; omitting the va-
3, and 4—vulgarly *pierre de corne.*
; species must not be confounded with the *hornstein* of the
mineralogists: it has been seen that this was a silex.
e must also be distinguished from the *roche de corne* of
, which seems to be a trap rock, in the acceptation that we
ıat word, according to Mr. Werner."

possesses sufficient tenacity not to be scratched by the copper knife, which, on the contrary, leaves its mark. It is even difficult sometimes to be scratched with iron.

" *Cornéenne* is easily melted into a *black* bright amel, and this character distinguishes *it* from schistus, when it possesses the texture of it, and from schistose jasper, when it approaches it by its hardness: it almost always acts upon the magnetic needle.

" Most mineralogists look upon this rock as an intimate and invisible mixture of amphibole* and clay.

" We shall establish the following varieties in this species:

" 1. Compact *Cornéenne.* It is
pact, difficult to break; its frac
passing to the conchoidal.

" I will give, as an example
the brown paste, approaching to
the amygdaloids of Drac. Dolom
it as a *cornéenne* well characterised.
of the amygdaloids of Derbyshire,
stone, should be equally placed with
of the agates of Oberstein, &c.

---

* An absurd name for hornblende or si , i
ambiguous, while there is no substance less

. Trap *Cornéenne**. This variety is hard; rs iron, but does not sparkle; it is com- its grain is consequently fine, close, and tely dull. This is what distinguishes trap basalt; the latter always showing in its re a grain rather crystalline. It breaks in elopipeds: its fracture is sometimes con- al. Its most general colour is black, but is some, bluish, greenish, and reddish. l.)

he trap here mentioned is an homogenous It is easily distinguished by its charac- om the trapose rocks.

his rock is very common in several parts eden.

. Lydian *Cornéenne*†. This *cornéenne* is , dull, compact; it is softer than the trap, *néenne*, and has not the parallelopided frac- it is, on the contrary, perfectly compact, ometimes rather schistose: it is scratched nly by iron, but also by copper, when the or edge of a piece of copper is applied; vhen this rock is rubbed with the flat or

---

Corneus trapezius. Wall. *Trap* is a Swedish word, which tairs. This name has been given to this *cornéenne*, because untains which it forms present a kind of steps or seats in clivities." (Wall.)

Corneus trapezius. *Lapis Lydius*." (Wall.)

rounded part of a copper instrument, it receives the mark of the metal. It is by these characters that it is distinguished from the blackest and most compact argillaceous schisti; they being always scratched by copper, and never receiving any mark from it, however applied; besides, schisti do not melt like *cornéenne*.

" It is on the property, which t
cornéenne possesses, of receiving the r
tain metals, that the use that m
stone, to judge by sight of the q ty
is founded. It is vulgarly called t
It has also the name of Lydian,
ancients gave that name to touch
no longer comes from Lydia. T
used come from Bohemia, Saxony,
I dare not however affirm that the
of those countries are all related to
of *cornéenne*. It is even pr
greater part among them are l

" The Lydian *cornéenne*, of
treating, is that used as a tou

" * Touch-stones, and the manner of u th
of more in detail in treating of the uses of . It is
different kinds of stones are used as touch-st
jaspers, and perhaps even basalts. Waller t
guished three kinds of touch-stones, which
of rocks, basalt, schistus, and *cornéenne*."

goldsmiths and assayers of Paris. I have
no other sort among them. It is so much
better, as it is blacker, and more compact.
s certainly, properly speaking, neither a ba-
nor a schistose jasper. It is said to come
Germany, by the way of Nuremberg: but
e who sell them know nothing more of it.
Cornéenne belongs either to primitive or
sitive earths. It never contains organised
ile bodies. Sometimes it forms thick beds,
etimes it presents itself in masses, in which
stratification is not perceptible. It consti-
s in this instance the base of certain amyg-
ids, or glandular rocks."*

rochant is equally perplexed. The *cornée-*
, he says, is sometimes siliceous schistus,
etimes Lydian stone, sometimes the clay-
e of Werner, hornblende slate, wacken, trap.
appellation so vague ought to be finally dis-
sed. The other *pierres de corne* of the French
be found in their proper divisions; but as
t analysed by Saussure himself contained
gnesia, which rarely occurs in the stones
ve mentioned, it is proper to confine his
strious name to the present division, which
scarcely attracted the notice of mineralo-

---

[*] Brongniart, i. 550.

gists. Mr. Kirwan has indeed observed, that serpentine is sometimes intimately mixed with hornblende, or trap, in which case it is black. It may in that case be regarded as a transition from serpentine to Saussurite; and the connection between trap and serpentine has been already observed by Werner.

Saussurite, in rolled pebbles, from the lake of Geneva.

The same, from the Alps.

Saussurite, with nodules of steatite, western isles of Scotland.

With veins of amianthus, fr

This substance is common

evinces its magnesian nature.

MODE VIII. GREEN GRANITEL.

A genuine green granite, f
ancient monuments of Egypt, h
described in the account of that r
beautiful substance is so extremely
cannot interfere with the present
Egyptian is composed of quartz,
Of Vosges. emerald green felspar; while t
here implied seems a mixture of ls
derite with steatite, the hav

ıetrated the felspar, and imparted its usual
·en colour, whence it has received its common
pellation.

It is found in the Vosges mountains in France,
d there is a manufactory at Paris, where it is
into tables, vases, chimney-pieces, and other
icles of decoration.

Che fracture has the soft unctuous appear-
ce of a magnesian rock, and the obscure green
our is a further characteristic of that class of
nes, so that there seems little doubt but it
st belong to this Domain.

imilar granitels are found, it is believed, in
stmoreland, and in Ireland. Occasionally
e crystals of the felspar are large and regu-
, when it assumes the form of a porphyry.

MODE IX. MAGNESIAN LIMESTONE.

Many limestones are so much impregnated
th magnesia, that their qualities become al-
ed, and they are injurious to vegetation.
cording to Dr. Kidd, the limestone of parts
Derbyshire, Nottinghamshire, and Yorkshire,
of this kind; and at Matlock the limestone
the rocks on the side of the river where the
ises are built is magnesian; on the other

pure. Mr. Tennant has analysed the st
ployed in two remarkable ancient bı .

"STONE OF YORK MINSTER.		"STONE OF WESTMIN-STER HALL.	
Carbonic acid .	47,00	Carbonic acid .	47
Lime	33,24	Lime	33
Magnesia . . .	19,36	Magnesia . . .	17,76
Iron and clay .	0,40	Iron and clay .	1,60
	100,00		100,00"

But the most remarkable stone of

Dolomite. Dolomite, resembling a primitive gr
stone, but which, according to
contains not less than 45 of m
form of carbonate. This stone recei
from Dolomieu, who observed it
remains of ancient sculpture at Rome; and
wards discovered it in the moun Tyrol.
It has been classed among the prin re
bles; but the essential difference tl
fluence of the magnesia prevents i xe
with acids, unless previously pulve
the calcareous particles are affect
posure. It is also sometimes p
when scraped in the dark, and
plates. It sometimes contains ve
mica, like the primitive marble called (
In appearance it differs but little from g

tone. The Apollo of Belvidere, and some beautiful statues, are said to be formed of mite.

olomite forms arrects, or uprights, extend-rom the base to the summit of the Alps of l; whence it has become a proverb in the :ry, that no mountain exists without a hat aestone*. It is sometimes in large masses, times in thin layers, alternating with foli-us mica. Saussure, § 1929, observes, that of the primitive limestones of St. Gothard Dolomites; and they often contain the para-substance called tremolite.

STRUCTURE I. MAGNESIAN LIMESTONE.

om the North of England, and various other tries.

STRUCTURE II. DOLOMITE.

pect 1. *Entire.* From the ruins of Rome.
·om the Alps of Tyrol.

spect 2. *Mingled.* From St. Gothard, with olite.
1e same, elastic, with foliaceous mica.

---

* Patrin, ii. 309.

MODE X. GREEN MARBLE.

In most rocks the green colour
presence of magnesia, whence
emphatic epithet. In t
this effect is not observable, ai
talcous particles are int ely c
the calcareous; but where t y e
apart, as in the green gran
the colour becomes characteris . T
is also called sometimes ser i
cause in fact the green parts k g
called serpentine, while the
calcareous. These marbles have
classed with glutenites, being neit r
pudding-stones, but an irregular
compound of serpentine and mar
the former is preponderant.

Verde-antico.

The most celebrated rock of tl
is that called the *verde-antico*, or
in which a green serpentine with
seemingly rather argillaceous, is
with a pure white marble. This is t I
marble of the ancients, of which t re
quarries near Mount Taygetus; and
rightly characterised it as more cheer

ther. But the whole passage again de- attention: "Some marbles are esteemed PRECIOUS, as the Lacedemonian green, cheerful than all the rest. So ALSO the stean, and afterwards the Tiberian, first ered in Egypt in the reigns of Augustus iberius. The difference between them and s is, that the latter is spotted like a ser- whence it received the name; while the present spots of a different form, the stean being crisped into wavy spots, while Tiberian the white (*canities*) is scattered, nvolved."

h is this celebrated passage, which has led ny errors in mineralogy, as it has been ved that the ophites was green porphyry, at the other kinds were green; whereas it r from the subsequent part of Pliny's de- on, that the ophites was grey or whitish, a spotted ollite, and when the spots were den mica it became the most esteemed *Thebaicus* of the ancients. In like man- le "*sic*, so the Augustean," only implies oth were esteemed very precious, like the ian, but not that they were of a green *.

---

the ancient testimonies concerning the green marble of the reader is referred to the learned work of Blasius Cary-

A recent French author gives the f account of the *verde-antico;* but he is cer mistaken when he regards it as a bricia.

" The *verde-antico* should be coı ed as a kind of bricia, the paste of which is a ture of talc and limestone, and the fı s, of a greenish black, are owing to serpe less pure. This marble is an aggrega marble and green serpentine, reduced pieces, or blended in its paste, and giving green colour, more or less deep.

" The *verde-antico* marble of the fi is that of which the paste is of a g and the black spots are of serpent sort called noble serpentine. It sprinkled with white spots, which ı more gay than when they are wanti .

" This marble is much esteemed in but large pieces of a fine quality are found. Nevertheless there are four b columns in the Hall of Laocoon, leon Museum; but there are much Parma.

" It was known by the ancients name of *Spartanum*, or *Lacedæmonium;*

ophilus (Biagio Garofalo) *De Marmoribus Antiquis.* 4to. Some extracts may be found in the Appendix. account of the ancient marbles in Domain V.

formed it was dug in the environs of Thes-
ica, in Macedonia, which at present forms
of European Turkey*.

This *verde-antico*, properly so called, must
e confounded with the marbles known by
ames of *vert-de-mer*, or *vert-d'Egypte*. The
erde-antico is a bricia, and never is mingled
red spots, while those just mentioned are
d marbles, mixed with a dull red substance
h gives them a brownish hue, not very
able. Besides, it is one of those marbles
n decompose in the open air."†

is decomposition is rather a proof that the
st parts are of an argillaceous nature. Dr.
regards the genuine *verde-antico*, which
be carefully distinguished from ancient
porphyry, and from mere serpentine, as
irregular breccia, consisting of fragments
rk grey compact limestone, black argilla-
schistus, and white granular marble, im-
d in a species of serpentine, which here
here is of a uniformly green colour, and a
derable degree of transparency, very closely
mbling jad, or compact talc.

The fragments of white marble are very sin-
y fringed, as it were, with a green sub-

---

* A gross mistake, and glaring inconsistency.

† Brard, 333.

stance, which, proceeding in the form of close parallel fibres from every part of the edge, penetrates into each fragment to the extent of about the tenth of an inch.

"This appearance is of difficult explanation; because it seems that the penetration, being so regular, and accommodated to the outline of the fragment, must have taken place subsequently to the formation of the breccia."

It is certain that different speci
substance have great variations, as
they are from different quarries.
pieces of clay-slate easily
from the mass; but in the finest f
whole is so intimately blended toge
general appearance so different fr
bricia, that no artist nor antiquary
plied this name to the Spartan
the new quarry in the Isle of A
resemble the *verde-antico;* but
posed that beautiful stone to
polzevera of Genoa is in like
serpentine, with veins of white
never classed among the bricias.

Others, Antique.

There is another ancient and very
ble, of a deep green, with little distant
black spots, and fragments of entrochi
into white marble. Another rare k

rble, being of a bright green, shaded
lackish green, so as to form long veins,
fracture in splinters like that of wood.
s a table of it at the Hotel de la Mon-
Paris*.

Modern. Polzevera.

odern green marbles, the polzevera, al-
entioned, is so called from a mountain
orth of Genoa. This marble often pre-
d calcareous parts†, like that of Angle-
t in the latter the red, and even the
eem so intimately combined with mag-
articles, that they do not effervesce with
ous acid, while in the *verde-antico* the
cence of the white parts is very strong.
lzevera is common in ancient chimney-
both in France and England, for exam-
the British Museum. There is also a
nd white marble, found at Suza, in Pied-

Of Campan, &c.

green marble of Campan, and other dis-
f the Pyrenees, also consists of limestone
with talc; but the structure is so singu-
at it is classed among the Anomalous
The Isle of Elba also presents a white
veined with dark green; but the green
of Florence seem strictly to belong to

---

* Brard, 335.

† So our author, but the red seem serpentine.

serpentine, as probably does the Sicily. A green marble, resembli *antico*, is also found at Grenada, in

What is called at Paris *marbre* serpentine, from Portsoy. But o beautiful green marbles yet di

Of Anglesea. Anglesea, which sometimes resem *antico;* in other parts is inte coloured veins; and in others red and green of dissimilar int ty. It appear, as already mentioned, t e careous parts are much impr d nesia, or, in other words, are I marble was long since described b and latterly by Coquebert.

MODE XI. MAGNESIAN INTRITE.

Serpentine porphyry. The chief rocks of this descri observed, are what have been ca and serpentine porphyries, the latter near Florence. The base is of the of these two substances, intersp or smaller crystals of felspar.

Magnesian intrites also exist with cr quartz, or calcareous spar.

To this Mode may be referred th rocks, described by Saussure:

A steatitic rock, with crystals of rose-cooured felspar. § 154.

He describes, § 1437, what he calls a serpenine porphyry, but really an intrite with small crystals of actinote.

A hard green serpentine, with spangles of a brighter green, semi-transparent, and resembling wax; being seemingly a secretion, or confused rystallisation, of the purest parts of the stone. May not the same remark be applied to porphyes, &c.? § 959.

Steatite, crystallised in ollite, the crystals being laminar, and of a grey inclining to green. 1851.

MODE XII. MAGNESIAN GLUTENITE.

This Mode presents, as usual, two Structures, he large and the small grained.

STRUCTURE I. LARGE-GRAINED.

Magnesian bricias.

A late ingenious writer gives the following account of two curious magnesian bricias, the latter however being more strictly a pudding-stone.

"1. *Steatitic bricia of Corsica.* This bricia, he steatitic base of which is of a reddish white, contains fragments of the same substance, which

are angular, in general small, some of which
of a blood red, and others of a grass
beautiful rock, which resembles in i
rock called lard-stone, used by the (
discovered by M. Rampasse in C
department of Golo. I could have
given it a more exact locality, on
would be highly interesting to work
steatitic bricia: but M. Rampas re-
fused it.

"2. *Steatitic bricia of Mo e Nero.*
steatitic bricia of Monte Nero is
tle torrent of Orsara, in Liguria. I
base wholly talcous, like the preceding,
of a calcareous base of a cherry red, a g
nular and scaly fracture, and only its spots
owing partly to pebbles of serpentine
chio green, and partly to some globules ni
diallage. It sometimes happens that
serpentine are surrounded with wl ri 1
farther relieves the richness of this bri-
cia, which was discovered by M. Viv
mineralogist*. It is to be r d
is not yet known, it being only fou
masses, in the torrent of Orsara."†

Mr. Kirwan mentions among the

"* Viviani, Voyage in the Apennines of Liguria, p. 16."

† Brard, 482.

f Cronstedt, consisting of indurated
xed with micarel, or felspar, or schorl,
ine; but this is rather a mingled mag-
, as is the serpentine, interspersed with
a, limestone, or garnets.

uthors, as already stated, regard the
o as a bricia.

TRUCTURE II. SMALL-GRAINED.

ave scarcely been observed*.

---

the *rag-stone* of Da Costa, p. 173, is of this kind,
nish grey, and of a talcous appearance. It is used as
a fine edge.

DOMAIN V.

CALCAREOUS.

CALCAREOUS EARTH.

THIS important substance is produced by burning limestone, marble, or chalk; and is commonly known by the lime. The purest is yielded by calcar spar, or some white marbles.

Its taste is hot and acrid; and it is incapable of fusion, even by the burning-glass.

ay however be fused when joined with or clay.

imestone is composed of lime and carc acid. Heat separates the latter, and lime is left pure. This acid is a speof gas, formerly called fixed air, and overed by Dr. Black in 1756; an event ch formed a revolution in the history hemistry. Atmospheric air is composed bout seventy-four parts in the hundred nitrogen, and twenty-six of oxygen: the latter varies; and there is comly one in the hundred of carbonic acid Hence lime exposed to the air ab- the carbonic acid, and may again ne a carbonate, or limestone.

architecture, mortar is composed of lime and sand; and when mixed proportion of iron, or manganese, it es extremely hard, even under water. en combined with sulphuric acid, the ous earth forms gypsum, or selenite, being burnt produces what is called of Paris. The alabaster of the mommonly belongs to the same combination; while that of the ancients is often a stalagmite, or secretion of common limestone. With fluoric acid, calcareous earth becomes fluor, or fluate of lime.

The greater proportion of limestone is produced by the decomposition of marine shells; but the more ancient, which is crystallised, and presents no trace of such remains, is called primitive, being supposed as ancient as any of the rocks. It is in general easily distinguished from the other substances by the nitrous acid, formerly called aqua-fortis, which excites effervescence; but when mixed with m
much silex, this effect is slowly procured. Nor do gypsum nor fluor effervesce.

To these observations, which are chiefly extracted from Kirwan, Thomson, and Patrin, it may be added that, in 1808, Mr. Davy reduced lime to a metal,
the colour and lustre of silver, and
with an intense white light into c

In some works of mineralogy the
three Modes of this Domain, and ev
three succeeding, have been ar

re *sub-species*, or varieties of limestone.
rict chemical analysis may probably dis-
ver a different proportion of ingredients,
, for examples, more water of crystallisa-
on in marble, and more or less silex or
gil; and there is at any rate a difference
the mode of combination. But the chief
e of any system being to assist the me-
ory, even the strict precision of terms
comes mere pedantry, if it be not sub-
rvient to this main object. Too large
asses of colour, or too small, will render
e picture equally inelegant and obscure.

MODE I. MARBLE.

Characters. Texture, large or small grained, generally in distinct concretions; sometimes so fine grained as to appear compact, and only distinguishable by its glimmering lustre: admitting a fine polish.

Hardness, of course marmoric. Fracture, foliated. Fragments, amorphous, blunt.

Weight, granitose.

Lustre, from glimmering to shining; between pearly and vitreous. Somewhat translucent, but the black only on the edges.

It chiefly consists of about 50 lime, and 40 carbonic acid; whence it is called by chemists a carbonate of lime.

The most common colours are white and black; but the others are so numerous, that they may be best observed in the subsequent enumerations of various kinds of marble.

For the geognostic relations of this celebrated rock, the reader is referred to Mode III., where, in treating common limestone, a wider field of observation may be opened.

Mineralogists have sometimes regarded marbles as primitive which present what call a granular fracture, of a shining or

arance; while those with a dull earthy frac-
were regarded as secondary. But Brard
vell observed, that a true white saline sta-
y marble, presenting every character of the
itive, may be of very recent formation, as
ars from the constant depositions of the
rs of St. Philip, in Tuscany, and of several
r regions. Marbles of an earthy fracture
been found even among those esteemed the
primitive of the Alps.

arble is distinguished from limestone by
rior weight, and by superior hardness and
pactness, so that it assumes a brighter po-
But many of the alabasters will scratch
le, being of course of a still harder nature.

Use in architecture.

hile the Egyptians often employed the eter-
granite, the Greek and Roman architects,
required greater roundness and softness
rms, chiefly used marble, as more easily
ght, and likewise more abundant in their
tries. Nor does its duration seem much
ior to that of granite, or porphyry, when
ciently pure and unmixed with argil; for
to mention the beautiful statues (which are
under shelter), ancient temples have suf-
more from the hand of bigotry or bar-
m than from the lapse of time. Marble is
ever exposed to accidents which could not

affect granite, or porphyry. A singular e
Temple of Serapis.
ple occurs in the ruins of the temple of Se
on the delicious coast of Baiæ,
large columns of Cipoline marble
by pholades, a kind of sea snail, whi
deep holes into limestone, whence ex-
tracted, and called sea-dates, being of
the Italian repast*. These perf
to not less than sixteen feet above
the sea; whence some have argued that
ter has subsided, while others sup
land has been raised by earthq A
probable and easy solution w ld
columns have belonged to some m
edifice, which may have been r
earthquake, and fallen into the
which conveyed them may have
or, in fine, the pillars left partly
mark for a certain space of time. T
very temple, the Pentelican marb
and the African bricia, occur; and
known, from many examples, that
transported obelisks and columns f
countries, to adorn Italy.

Primitive.
The celebrated Buffon had adva
nion, that all calcareous rocks were

---

* Breislak, ii. 163.

ins and depositions of shell-fish, and other rine animals. The first who combated this nion was Palassou, in his celebrated essay on mineralogy of the Pyrenees, published in 31; but which, through the excess of admiion for Buffon, fell into oblivion. The opin was however soon after revived and conned by that illustrious observer Saussure, ecially in the latter part of his journeys among Alps. Patrin says that he has frequently nself observed, in the immense mountainous ains of Northern Asia, from the Uralian to river Amur, for an extent of more than 1000 gues, beds of marble, which it was impossible suppose for a moment to have been posterior the other beds of primitive rock, in which ey were enchased. He also regards the chains calcareous hills, mingled with clay-slate and rpentine, which appear at the bottom of the lps, and other lofty mountains, often in layers ntorted in the strangest forms, but still unoken, as being caused by the tumescence of e granite, while these depositions were still of soft consistence.

" Where the thickest calcareous beds subsided themselves, they formed homogenous masses, thout any divisions, or at least there are only cidental fissures. These marbles are granular, and palpably crystallised in all their parts; are generally of a single colour, white, red, or black, and without any mixture reign substances, except a small ty silex, which is intimately combin presence is only found by dissolvi in acid. I have tried some of the pur in this manner; I always obtained sediment; the quartz at times is so that these marbles yield sparks a

“ It is these large masses of hor bles which furnish the fine white sta y such as those of Paros and Car never in any very elevated situati

“ Those which are found interp schistose layers, or mixed with beds of tine, yield the marbles called *Cipol*, present long veins parallel to each undulated in various directions. T met with in the neighbourhood of of mountains.

“ I have no need to mention that bles never contain any vestige of shells, marine productions, as their form is anterior to the existence of all organised

“ Some are found which contain r taedral iron, and even pyrites, the sa mitive schisti. Romè de l'Isle says, that in

nest white Carrara marble he has seen blackish
ots and veins, produced by a multitude of very
nall crystals of octaedral iron, affecting the
agnet, exactly like those which are found in
e ollites of Corsica.

" Ramond, in the interesting description which
gives of the peak of Eres-Lids, near Barège,
ys, that on the summit of that mountain cal-
reous beds are observed, which constitute a
eenish-white primitive marble, entirely sprin-
d with small duodecagon garnets, round,
ake, of the size of the head of a pin. Another
riety presents garnet in large irregular crys-
s. These beds of marble alternate with beds
rocks which are indubitably primitive.

" I have already observed, that calcareous bri-
s are nothing else than the primitive marbles
emselves, the beds of which have been over-
rned, while they were still in a soft state."*

It is equally probable that the calcareous and
gillaceous rocks may, in a soft state, have sub-
led from the granite, which had previously
ystallised in arrects of great steepness.

Arrangement. The subject of marbles is almost infinite, as no
ineral substance affords such innumerable di-
rsities, or has so much attracted the attention

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* Patrin, ii. 304.

of mankind. In a scientific point of servient to the general plan of this tr may be divided into four principal st Granular; the Compact; the C containing shells; and the Zoo with madrepores, &c.; beginni found in ancient monuments, and the more modern; the colours garded as *varieties:* though rarity and singularity, as, for e venular marble of Durness, a Bleyberg and of Castracan, or C ria, falsely ascribed to Astracan, form *diversities.* The bricias, will of course be described a Glutenites*.

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* The division of marbles by a scale of Daubenton, has been found alike useless sides the six divisions here adopted, of Gra chitic, Zoophytic; with Serpentine marbles, might be the following subdivisions, or aspects:

Uni-coloured, white, black, red, &c.
Straight-veined.
Mazy, with irregular short veins.
Mixed, equal spots of various colours.
Spotted, large spots.
Speckled, middling spots.
Dotted, small spots.
Ocular, like eyes, *occhiato.*
Streaked, long spots, &c. &c.

STRUCTURE I. GRANULAR.

In general the ancient and finest marbles belong this description; though an ancient white or rey, called *palombino* by the Italians, and that of roconnesus, not to mention a few others, are of fine earthy grain, almost compact.

Egyptian.

The first attention is due to the Egyptian monuments, as from that country the arts passed to Greece, and subsequently into Europe. The arble statues and fragments described by Wad re very small, from 10 to 20 inches in height, nd present the following colours; milk-white, e same with venular silver-white mica, greyish hite, passing to blue, and yellowish white. The hief Egyptian monuments are in granite and asalt.

Rosso antico.

But in the Museum at Paris, and other princely ollections, there are many Egyptian statues, and ther monuments, in the *rosso antico*, the ancient ed, the peculiar marble of Upper Egypt, or of thiopia, for the cataracts were anciently reputed divide these countries; and Syene was esteemed e last town of Egypt, on the very confines of thiopia.

It seems evident, though it has escaped all the itics, antiquaries, and mineralogists, that the perb *rosso antico*, which, in the grand statues

of Agrippa (formerly in the Pantheon), t
nous, Indian Bacchus, and other exqu
surpasses in beauty all the other r
celebrated *Augusteum* and *Tiberi*

1. It is allowed that this mar
Egypt; and, even in the time of P
fully distinguished from porphyry,
from the same country.

2. It was natural to give the i
the imperial colour, which was red, as is k
every classical reader, and the very
phyry evinces. Our purple is the
lacea, or violet purple of the ancients.

3. The other colours were cele
The black was called Lucullean, fr
as Pliny says. The green of Laco
of Numidia, were all well known: a
the only new colour of marble. Bo
that the Augusteum was *cinereum*,
because it is ranked with ophite: but
known Greek and Italian marbles
very common colour.

4. The *rosso antico* alone presents
larity mentioned by Pliny, and which he
as usual, in the most chosen and emp
guage: *Tiberianum* SPARSA *non* ca
NITIE*. For the ancient red is often

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* Edit. Brotier. Some erroneously omit the non.

ver with white dots, like hoar frost. The *usteum undatim crispum in vertices* is the *fiorito* of the Italians, with little tufts or ers of white.

Because the other stones, mistaken for the rian and Augustean marbles, are now known o be Egyptian, just as the green porphyry, or nded ophite, is not Egyptian.

he *rosso antico* therefore is rightly styled ptian*. Brard describes this beautiful mar- as of a deep blood red, with little distant k or white veins, and often sprinkled with lit- hite dots. Such is the Egyptian Antinous; two ancient seats used in the baths, and the of an Indian Bacchus, are free from the , though the dots be always visible. The rated statue of Agrippa, son-in-law of Au- is, in the Grimani palace at Venice, is of this rial marble, intended perhaps as a special pliment†.

he *rosso annulato* is red, with round white s; the *seme santo*, red, with little triangular

---

mperati, and Wallerius, i. 134, say the *rosso antico* was from Egypt. As Syene was on the borders of Ethiopia, it is also *Ethiopicus*. (See App.)

good engraving is given in Dr. Pococke's Travels in the vol. ii.

spots. One of these may be the *Claudianum*[*], if it be not another name for the Tiberian. Gordian's villa had fifty Carystean columns (green); fifty Claudian (red?); fifty Synnadian (white, spotted with bright red, *porto santo*[†]); fifty Numidian (yellow).

Of Paros. In passing to the Grecian first
marble of Paros, sometimes called
the ancients, because the quarries were e
by lamp-light. A transparent kind,
gites by Pliny, was also found in
is said by Chardin to occur in Pe
is reported by Suetonius to have f
a kind of stone that reflected the figur
behind him, corruptly called *phengites*,
probably a fine black marble.

The Parian marble was employ by
ancient Greek sculptors, about t

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[*] Hist. Aug. 676.

[†] Perhaps the *fiore de persico*, or peach bl
may observe the original quarries in Natolia.

The *rosso antico*, when unpolished, is of a dark
which obscures its difference from ophite. But as,
metals, Pliny begins with gold and silver; and
mond and the emerald; so in marbles he l
precious, as he says, the Laconian green, the I
ophite. Any relation of colours or qualit in
only the *value*.

ut being of a yellowish tint and coarse
was afterwards supplanted by the marble
, in Etruria, as afterwards by that of Car-
the same vicinity.

e great museum at Paris, the Venus de
Diana hunting, Venus leaving the bath,
ssal Minerva, the Juno of the Capitol, the
called Cleopatra, and several others, are
n marble. The celebrated Parian tables
rd, which have illustrated many points of
chronology, are also inscribed upon the
one.

Pentelican.

lican marble, from the vicinity of Athens*,
, like the former, but with a finer and more
t grain. It sometimes presents blackish
rom a siderous mixture, and sometimes
eins of the talcous kind, so that it is at
alled statuary Cipoline.

of the noble monuments of ancient Athens
structed with this marble; and several sta-
e extant, as in the Museum of Paris, a
s in repose, a Jason, a Paris, a tripod of
, &c. &c.†

Greek, so called.

vague name of *Greek* marble has been

---

cerning the mines of Attica see Xenophon *de Vectigalibus*.
d, 324. Petrini says, ii. p. ix, that the Pentelican, with
s grains of chalcedony, as the Carrara has rock crystal:
from a mixture of argil.

given to a fine-grained and hard kind, of a snowy whiteness. It was from several islands in the Archipelago, as Scio, Samos, &c. In the Parisian Museum, which derives its name from the Emperor Napoleon, there are an Adonis, a *Bacchus*, the philosopher Zeno. The Fawn is *supposed by* Brard to be of the marble called Coralitic by Pliny, because found near the river Coralius, in Asia Minor, and which, in whiteness and grain, resembled ivory. Some assert that the finest statue in the world, the Apollo of Belvidere, is formed of what is called the Greek marble; but most mineralogists infer it to be

Translucent. At Venice, and in different towns of are columns and altars of a singular translucent, that the light of a ca through pretty thick masses. This is Cappadocian *phengites*.

Elastic. Tables of ancient elastic marble palace Borghese at Rome. It has asserted that this quality may be certain modification of heat, w structure, so that the calcareo certain directions.

Of Luni, in Italy. White marble of Luni (the ancient Lu Carrara, on the shores of Tuscany, these two places be nearly adjacent, assert that the marble of Luni is finer

arrara, and free from the grey veins that some-
imes appear in the latter. The Antinous of the
apitol is said to be of marble of Luni. That of
arrara, as just mentioned, often presents grey
eins, so that it is difficult to procure blocks of an
niform white. It has been much used for chim-
ey-pieces in England; and is often mingled with
e yellow and dull purplish bricia of Sienna: but
e quarries are said to have been opened at least
early as the time of Julius Cæsar. The Car-
ra marble has sometimes greenish talcous veins,
ke the cipolino, and sometimes crystals of iron.
ut the most beautiful specimens are those which
ntain, in little cavities, rock crystals of the
arest water, called in Italy diamonds of Car-
ra.

White marble of mount Hymettus, in Attica; Of Hymettus.
ather inclining to grey: but it was the first fo-
eign marble introduced at Rome, where this mo-
erate magnificence was thought so extraordinary,
at Crassus the orator was exposed to the sar-
asms of Marcus Brutus, because he had adorned
is house with six columns, twelve feet high, of
ymettian marble. Such were the chief white
arbles employed by the ancients.

The ancient black is so intense that, when Ancient black.
aced beside those of Dinan and Namur, it makes
em appear grey. Some pedestals and busts of

this marble still exist, but this ki
rarity*. Perhaps age may have re er
lour more intense. Black marble
serve as a touchstone; but the test
cannot be applied. Monuments of
may be revived by anointing them

The ancient green marbles have
partly described among t M
The Appendix may be also c l.

Ancient marble, in long regular v
and grey.

Ancient marble, of reddish white,
a slate blue, disposed in festoons.

Ancient marble, of a deep red, v
grey and white veins, supposed to

Yellow. The ancient yellow, of three ki s,
resembling the yolks of eggs;
deep yellow rings, whence it is
Its place is imperfectly supplied th
marble of Sienna. The ancient
dia, in Africa, as appears from
writers†.

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[*] It is supposed to be from Tenarus, in Laconia, and entirely dissolves in the nitrous acid. Petrini Gab. Naz. i. 143.

[†] See the Appendix; and Gibbon, vii. 201. For it came from Mount Maurasius, or Aurasius, the citadel and garden of Numidia, near Lambesa, once a Roman city of 40,000 souls. Sitifi, which yields the turquin marble, is in the same quarter.

Other ancient marbles will appear among the Calcareous Glutenites. To enumerate modern marbles would be infinite, but the more remarkable of each country shall be selected, giving the usual and due preference to our own.

England.—Some of the most beautiful will be found among the Conchitic, or shell kind. The black marble of Derbyshire. Intense black marble, with distant white spots, Somersetshire. The Cottam marble, found near Bristol, has black dendritic delineations. Brown marble, variously veined, from Devonshire. This is the marble from Plymouth and Torbay, mentioned by Da Costa, as of a fine deep black, beautifully variegated with irregular veins of red, yellow, and white. Much was brought to London, and worked into chimney-pieces, tables, &c. He also describes a marble of a dull yellow, with many dots, streaks, and spots of black, as found at Yeovil, in Somersetshire; and elegant tables of it may be seen in that county, though it is not capable of a fine polish*. The green and red marbles of Anglesea have already appeared in the Talcous Domain†.

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* Fossils, p. 221, 216. The Devonshire marble is mostly dull, of a grey or a pale red, with spots of a deeper colour. It often contains madrepores. The black kinds, with red and yellow involutions, are the most elegant.

† Da Costa, p. 220, in speaking of the green marbles variegated

SCOTLAND.—White statuary marble of Assynt. White marble, with long veins of a different tint, from Durness. Red and white marble of Boyne. The beautiful rose-coloured marble of Tirey, mingled with siderite, &c. is reserved for the Composite Rocks. The same isle presents a beautiful white marble, with veins of nephrite. Numerous other marbles might be explored in the Highlands of Scotland; and a French author is singularly unjust when he says that the British

with white, mentions the Egyptian, which he rather supposes to be the Tiberian and Augustean (though no green marble be found in Egypt); then a second, which is the polzavera; and a third the green of Susa; and a fourth from Sweden. He then adds, "These are the chief varieties of this marble, which, besides the places already mentioned, is found in several parts of Europe; in the northern part of the island of Anglesea, in Wales, in the parish of Llan Fairyng Hornuy; and in Inis Molroniad, or the Island of Sea Calves, there are rocks of this kind of marble with veins of fine asbestos; and a quarry of the same marble is dug near Kemlyn, and another at Monachty, in the same island.

"Woodw. Cat. A. X. b. 3, exhibits a dusky green marble, veined with white, which he found in the way between Ambleside and Penrith, in Cumberland, where it is in considerable quantity: it probably is of the same species."

So ancient is the knowledge of the beautiful An which has been regarded as a recent discovery. In Mines* is an extract from Pennant's Tour in this marble; which is also said to be found in S isle near Anglesea.

* No. 16, p. 75.

les are poor in marbles[*]. It is only the fashion- le rage after foreign kinds, joined with an old utine of commerce, blindly followed by the ma- facturers, which prevent vast treasures of this coration from being discovered in Great Britain d Ireland; particularly in Wales, and the High- ıds of Scotland.

IRELAND.—Near the celebrated lake of Kil- ney are found white and red, and black and ite marbles. Indolence and ignorance have evented further research. The fine black mar- e of Kilkenny is conchitic; but the north of eland yields a brown marble, and one of a pale ite, like earthenware[†].

Having begun with these northern regions, it ay be proper to continue in the same climate, at the comparative view may become more stinct.

NORWAY.—The marble of Gillebeck, which sembles that of Tirey, will be described among e Composite Rocks. Even the Danes show a ore patriotic taste than Britons, for it has been nployed in constructing the church of Frederic

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[*] Brard, 442. Some of the Assynt marbles promise well, but quarries are not yet sufficiently deep to expect the finest kinds. iose of Italy have been worked for 1500 years. Adits might be ind advantageous.

[†] Da Costa, p. 210, says a grey marble, with white spots, from county of Cork, was much used in Ireland.

at Copenhagen. Many other Norw
are faintly described by Pontoppidan
cius; but there is no encouragement
ploration.

Denmark.—The Danish isl
coarse marbles, but none has att
notice.

Sweden.—This country has evinced its good
sense and patriotism in establishing considerable
manufactures of porphyry and ollite; but marble
seems rare and of little value.

Russia and Siberia.—On tl
cannot be a better guide than Patrin,
many years in these regions.

" In Siberia, the Ural mou
finest and most variegated marbles.
part are taken from the neighbour
inburg, where they are wrought, and
transported into Russia, and part
tersburg. The late empress caused
palace to be built there, for Orlof
which is entirely coated with these
both inside and out. It is situated
of the Neva, and is one of the chief
that capital. This empress built the
Isac with the same marbles, on a vast s
the statue of Peter the Great. This ch
not finished in 1787. I there saw c

large dimensions, which seemed to me to be single block, of a white and bluish marble, in veins: only this kind of marble was used in church. The palace of Orlof has many va- s, which are distributed in compartments.

I saw no white statuary marble in the Ural tains; but in that part of the Altaïan moun- which is traversed by the river Irtish, I in places saw enormous rocks of marble, per- white and pure, from which large blocks t be hewn. The only use made of it is to ert it into lime, for the service of the for- es situated along the Irtish."*

Grotto of Kungur.

e celebrated grotto of Kungur is by some to be in a coarse white marble, by others in ster. The village of Kungur is near the of the Uralian chain, on the confines of pe and Asia, about fifty miles to the S. S. E. e city of Perm, in the government of the name. It is said to be six wersts, or about gue, in length, and half as much in breadth. re are several openings in the roof, so that is a subterraneous meadow with grass and ers, a little lake, a rivulet rising from a de- ed rock, which, like another springing from a , soon loses itself underground; with natural stairs; an image of St. Nicholas, and crosses erected by the Russians. Gmelin, who occupied five or six hours in visiting a part of this remarkable grotto, adds, that it is not after all so singular as that of Bauman in the Hartz, and as the Neble Loch, or Misty Hole, in the Duchy of Wirtemberg *.

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* iii. 8.

On descending to the more soutl rn we find the Turks occupied in c v blest monuments of Greece into li ; exploring the ancient quarries of the among which Anti-Paros displays its c grottos in the purest white marbl lactites and stalagmites of the substance; and said to be as primitive. The beautiful green of I unknown to these barbarians.

GERMANY.—White marble of F of Hildesheim approaches to ivory; place likewise furnishes an ash grey. W greyish white. Osnabruck, fine l gyllen, spotted, white, yellow, Between Leipsic and Bareuth t re is chesnut and liver-colour, with veins tints. Ash grey, with black rami Goslar. Green, veined with yellc

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* See his Journey to Siberia, in the *Hist. Gen. des* I tom. 24, 4to. p. 128, where there is a ground plan.

ıe, from Salzburg. Red, from Ratisbon, , and Trent. Straw yellow, with black , from Hessia. It is only formed into ures; and, like the Florentine, is a marlite g in argil.

ERLAND.—In general dull violet, spotted with black. There are some of a bluish embling what is called the blue turquin, mes from Africa, and is spotted with and the blue marble of Narbonne; both however should be called grey, for no rble has hitherto been discovered, that eing almost peculiar to the precious out it appears in alabaster, a blue transnd of which is found near Nottingham*.

CE.—The most singular is perhaps the Narbonne, described by Patrin as of a e, spotted with bright grey. Brard says white, mingled with bluish grey, and is ghest esteem, being sometimes improperly arble of Languedoc. Of the beautiful le, which forms many chimney-pieces at , often spotted with a deeper colour, and s with white spar, I cannot discover the

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ountain of Cramont, near Mont Blanc, is composed of ble, of that kind which the Italians call cipolino; the large-grained, and confusedly crystallised, of a slate white veins and spangles of mica. Sauss. § 915.

site, if it be not the *griotte* of Canne,
Narbonne*, which is a deep red, spo l
white, or the Serrancolin, which is of a fair
mingled with yellow and grey, and is
river Neste, which joins the Gar
says, that fine large blocks of S
been raised for the decoration of t
of France. The Pyrenees furnish
as the green and red of Campan;
others mentioned by Palassou, the
white of Loubie, the grey of
Serrancolin already mentioned,
mingled with argil and talc, lil
Red, with yellow spots, from Poit
and yellow, from Tournus, which dec
churches at Lyons. Grey, veined
golden yellow, from Bourbon-l
white veins, from Caen in Norr
Marquise, near Boulogne, with la
and red veins. Many of the Flemi
black, veined with white; the ot
long to the Conchitic or Zoophyt

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[*] So says Patrin; but I can only find one C
Brongniart says *Cosne*, in the department of All Marb
jewels, being common objects of commerce,
tised, and many errors in consequence arise. But an
probably the Synnadic, is compared, by Tournef
and white of Cosne in Languedoc.

these may be added the following, indicated
ard. Spotted with red, white, grey, and
, from the vicinity of Mont Dauphin, in the
Alps. White, rose, and green, mingled
garnets, needles of lepidote, and shining
es of iron; this beautiful marble, of a saline
is found at St. Maurice, in the Val God-
ut it belongs to the Composite Rocks. St.
ce likewise furnishes cipoline. Deep violet,
d with yellow, from Narbonne. *Bariolé*, or
ed with various colours, white, red, and yel-
rom the mouths of the Rhone, much esteem-
ing called marble of St. Baume, and reputed
to Spanish *brocatello*. White, veined with
from the department of Mont Blanc, very
being combined with silex. Grey and white,
d with red, from Liege. Of a light coffee
, with white, grey, and red veins, from Bou-
Of Antin, white, with veins of a fiery red.
from the Pyrenees. Black of Dinan, bitu-
is: it is sometimes powdered with white
Black, or rather grey, of Namur, much
in Holland*. Isabella colour, with trans-
t spots of deep brown, from Mont Rouge,

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here it is called *blacuwe stein*, or blue stone. Hill, perhaps,
: Namur a town in Africa; for he gravely affirms this to be
midian marble of the ancients, which is literally *toto cœlo*

near Paris. Yellow, with black dendrites, from Rouen. Of St. Maximin, department of Var, much esteemed in commerce, and called *portor*, or the gold-bearer, because in that of the best quality it is black, veined with golden *yellow*[*]. White, from Civrai, reputed too hard by the marble-cutters, while this is in fact a perfection of marble.

Many curious marbles are a found
isle of Corsica, now subject to F e,
line of Corte; and the isle of El
quarries of white, veined with black
also the cipoline.

The French make great use of
of all kinds, &c. &c.; to which p
part be owing the infrequency of c
and no insurance company could der
advantage in that country.

SPAIN.—The milk-white of Cord
Filabres there is a mountain,
circuit, and 2000 feet in height, v
tire block of the purest white n
of the highest polish. This singu
three leagues from Almeria, in Gr
famous palace of the Alhambra, at Gre
partly constructed from the white marble

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[*] Da Costa, p. 203, says it was much used in England.

nd the town of Molina, in New Castile. In
eighbourhood of Grenada, white saline mar-
slightly tinged with red. Similar, but of a
grain, from Badajos in Estremadura. White,
large grey spots, from La Mancha*. Grey,
Toledo. Grey, veined and spotted with
e. Black, with grey and white, from Moron,
Mancha, and Biscay; which last also furnishes
ck, veined with ochre red. Violet, elegantly
ted with bright yellow, from Tortosa: this is
celebrated *brocatello* of Spain. Dull red,
ed and spotted with a lively red and shining
e, resembling *griotte*†. Of a dull violet, like
lees, with little orange spots, from Valencia.
-coloured, veined with white, from Santiago;
there is also an entire mountain of this kind
Antiquera. Fawn-colour, powdered with
Cortegana. Dull red, with black capillary
, Valencia. Near Morviedro there is a hill
lack marble, veined with white, which gradu-
passes into a yellow, blue, and red bricia, at
summit. Red, yellow, and white, of Molina.
veined with grey, from Guipuscoa. The

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he French call such a marble *Tigré*, it should be *Leopardé*.
ger is barred, the leopard spotted.

riotte seems originally to imply a large deep red cherry. The
dark spots might occasion the name.

others are Conchitic and Zoophytic marbles and
bricias.

PORTUGAL.—The mountains of Ar
nish some esteemed marbles. That Tr
a pale yellow, with grey veins, and
tains shells.

ITALY.—The chain of the A
chiefly calcareous, and Italy the seat
ancient monuments, and the parent
sculpture and architecture, it is
the Italian marbles have been hi
White marble of Padua, Pisa, Pilli,
all used in architecture in the no
cathedral of Milan is built with a
marble, veined with grey, from Mer *.
marble of Bergamo, of the most pure
tint, and finest polish, whence the
paragone. Black of Como, em
thedral of Sienna. Deep black,
veins. *Polveroso*, or powdered
sprinkled with little dots, so as to
White, with large black spots, fro
giore, used in the decorations of

---

* The primitive marble, white, with some veins o
which the cathedral of Milan is constructed, leaves in
acid white quartzy sand, with some pyrites and
Sauss. § 1771.

ches of the Milanese. The green of Florence
ngs to the magnesian, as does the *verde-di-*
do, so called from the little town of Prado,
as others say, from Corsica*. Slate blue,
ed with brown, from Margorre. Of Brema,
w, with white spots. Light red, spotted with
e, from the Veronese. Bluish grey, or what
lled blue, of Rosso†. White, with little spots,
dots of blood red, from Luni. The yellow of
na is one of those called *brocatelli*, or em-
dered, the colour resembling the yolk of an
in large irregular spots, surrounded with
s of a dull purple. The commerce with Li-
o, strangely corrupted by our seamen into
horn, has rendered this marble very common
ngland. It is certainly beautiful, but far in-
r to the green of Anglesea, or the rose, spot-
with green, from Tirey. Yellow, veined with
k, also from the neighbourhood of Sienna‡.
curious marble of Florence, stained with re-
blances of ruins, &c. and which, with the den-
ic, might be styled *pictorial*, being framed like

What is called the Egyptian green, is a polzevera from the
ity of Genoa. It is so called because it resembles the *verd*
ue, which was supposed to come from Egypt. See Da Costa,
0. Patrin says it is from Carrara.

The *pavonazzo* should be a *purple*, or dark blue.

At a place about nine miles distant, called Mont Arrenti, at
ead of the vale of Rosia.

pictures, properly belongs to the marlites.
or bright red inclining to yellow, like
called jacint, from Verona; but
presents ammonites, it rather belongs
chitic: the tomb of Petrarca, at Ar
engraved by Faujas, is of this mar A
red was used by the Romans in bu
amphitheatre of Verona. Six le
rona Faujas observed a singular l
calls bone-marble, being of the same n
with a greenish shade, and presenting large
spots, which are petrified bones; but
explained to what animal they bel
columns of this singular marble have
tracted*.

Sicily. The chief marble of Sicily is red,
stripes, like ribbons, white, rose-c
sometimes greenish, which at inter
forming pretty acute angles. This
ble is of the highest value†. Bisac
presents a milk white, but an apple g
takes the finest polish, probably
Trapani possesses a red, with deeper s;
another red, spotted with green; not to

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* Brard, 418.

† It is a heavy ferruginous kind, whence our marble
it *Sicilian jasper*. It is perhaps from Giuliano, in th
of Sicily, a spot famous for products of this kind.

potted with several colours, and one com-
of spots red and yellow. Castro Nuovo,
spotted with red. Taormina, red, spotted
lack, or a deeper red; yellow, spotted with
nd black; and a yet more singular, green-
ith bright brown spots; and a lilac, with
eflections. Termini, greenish, veined with
and dotted with red. Near Sciacca ap-
a bright green, waved with deeper green
llow. In the river Niso are found frag-
of red, spotted with a white semi-trans-
substance, like chalcedony.

Asiatic.

narble so much abounds in Europe, there
occasion to import it from the other con-
, and their products of this kind remain of
little known. In ASIA Dr. Shaw men-
dendritic marble of Mount Sinai, which
n confounded with the pictorial marble of
e, as appears from Wallerius. Persia con-
any marbles, mentioned by Chardin, parti-
the translucent white. The kingdom of
nd China, also present edifices of beautiful
narble. Hindostan does not appear rich
production. Some of the statues and mo-
s are rather of a coarse limestone than a

African.

AFRICAN marbles were among the most
ted of antiquity, when the northern part of

that continent was possessed by the Egy Carthaginians, and various Greek colonies, afterwards ruled for many centuries by t mans. As the intercourse with Italy ren frequent till the seventh or eighth century, is the less occasion for wonder that the t ition of the Roman artists should have pr the distinctions of some African marbles; a are not numerous, it will be more satisfac consider them all in one point of view.

What is called the ancient red, already scribed. This is dotted or powdered with white; but there is another kind with white sp

The dark red, with small triangular w , must also be classed among the Af ; red, with spots like flames. Similar i called *fioriti*, among which is a white or grey, w purple flames*.

Numidian. The ancient yellow, according to Boot and Walerius, and many ancient authorities, was from Numidia; as was the grey with yellow spots. Pliny, who informs us that ships were built for the sole purpose of importing marbles†, mentions the Numidian and Synnadic as being variegated by art, with inserted fragments. He reproaches the bad taste of those who altered the natural ppearance of marble, by insertions added to the atural spots, so as to represent animals and other bjects*; whence the Numidian was diversified ith artificial eggs, and the Synnadic with rich rimson spots, instead of the dull red furnished y nature†. In another passage he says that Lepidus first used Numidian marble in his house, ven his threshold being paved with it; whence e incurred public reproach for the new luxury‡. Four years after, Lucullus brought a marble to Rome, which was called Lucullean, being black, and found in an island of the Nile. But luxury assumed a far wider career, for ages after the time of Pliny; and many marbles unknown to that illustrious author must have been imported from Africa, and other countries.

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* For the African bricia see the Glutenites.

† xxxvi. 1.

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* xxxv. i.

† This precious marble was brought from the very centre of Asia Minor, Sinnada, or Synnada, being a town in the greater Phrygia. Strabo says, lib. xii. "Sinada is a town of no great size, before which is a plain of about sixty stadia, planted with olive trees. Further on is the village of Docimia, and the quarries of Sinadic stone; for so the Romans call it, but the natives Docimite. At first only small pieces were extracted; now, on account of the prodigious luxury of the Romans, immense and entire columns are hewn out, the stone approaching nearly to the *alabastrites* in variety. Many loads of this kind are carried down to the sea; and columns and tables of admirable size and beauty are exported to Rome."

See the Appendix, for a fuller account of the Synnadic, African, and other ancient marbles.

‡ xxxvi. 6.

A singular marble is still known to be found at Sitifi, in the north of Africa, being the proper turquin, because, like the turquois, it is supposed to be brought from a country subject to the Turks[*]. It is of a bluish grey, or slate colour, with spots of siderite or hornblende; and seems to be one of the most primitive.

American.

The common marbles abound in AMERICA; and the conchitic is found at the height of 12,000 feet in the Andes. The following observations are from Molina's admirable essay on the natural history of Chili.

"The calcareous stones which this country furnishes, are limestones, marbles, calcareous spar, and gypsum. Among the limestones some are found very compact, and of all the colours; as are the coarse-grained, while the common limestone is white, bluish, and grey. The marbles of a single colour hitherto discovered are, white statuary marble, black, greenish, yellow, and grey. Two mountains, the one in the Cordelera of *Copiapo*, and the other in the marshes of *Maule*, entirely consist of marble in zones of several colours; but in such strata as surround the mountains, from their base to the summit, with a symmetry that seems an artifice of nature. The variegated

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[*] Some say turquin, *turchino*, is derived from the blue colour of the turquois.

arbles are, the grey, with white, yellow, and
lue veins; green, speckled with black; and yel-
ow, with black, brown, and green irregular spots.
his last, the quarry of which is at San-Fernando,
he capital of the province of Colchagua, is in
reat esteem, because it is easily wrought, and
ardens in the air. All the marbles of Chili are
enerally of a good quality, and all take a good
olish. Persons who have had occasion to ex-
mine the lower Andes, have assured me that
hose mountains abound in marbles of different
ualities, and nearly of all colours; but the ac-
ounts I have received are too superficial to en-
ble me to give exact descriptions of them. In
he plains near the city of *Coquimbo*, a white shell
arble has been found, somewhat granular, three
r four feet under the vegetable earth. The shells
n this marble are more or less entire, and give it
ll the appearance of a real *lumachella.* The bed
f this marble extends in length and breadth more
han three miles; its thickness, generally about
wo feet, varies, and depends on the number of
he beds, which are sometimes five, sometimes
ight. These beds are almost always divided by
ery thin layers of sand. This stone increases in
ardness in proportion to its depth. The first
eds only present a coarse friable stone, of no use
ut to make lime: the following, although com-

pact, easily yield to the iron instruments used to cut it, and raise it from the quarry; but in building acquire a sufficient hardness to resist any impression of the air or water."*

Many curious marbles are also found in New
Spain, and in North America. T q
ries in the territories of the United it
Stockbridge, and Lanesborough, M
sundry places in Vermont and Pennsy
Amenia, in New York; and in Virginia:
of which fully equal the finest s
Europe†. At Marble Town, near H
are quarries of fine black marble, sp
white shells.

STRUCTURE II. COMPACT.

This division has scarcely been
mineralogists, except in a few
ing to Werner's system, it must cl
the transitive, and the floetz or
Some few examples have been alr
of very compact ancient marbles,
ture like the argillaceous substanc
palombino, and that which resembles i
called Greek, and the ancient b
also approach to this division.

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[*] Molina, St. Nat. p. 77.

[†] Spafford's General Geography, Hudson 1809, 8vo. p. 190.

Ancient.

Many of the marbles used in the Egyptian mo- uments appear to be of this description, and Vad has divided them into two kinds, the *densum*, nd the *lamellosum granulare*. Of the former re snow white, and yellowish white, reddish and ellowish grey, and Isabella yellow, passing to ellowish brown*. He adds that the *lapis Troicus*, f which, according to Strabo, the pyramids were hiefly built, must belong to this sort, as Niebuhr ays they are constructed of limestone full of por- ites, or nummulites, drawn from the mountains alled Mokattam, but anciently *Mons Troicus*. But, according to many specimens and recent ob- ervations, the pyramids are built of a beautiful ine limestone, which often contains shells. M. Rozière, an excellent judge, in the abstract of Egyptian mineralogy, which he presented to me, egards the two long chains of mountains, which confine on either side the long valley called Egypt, as being both of a calcareous nature, the sandstone only beginning about twenty leagues from the cataracts, a little above the town of Esneh. The celebrated tombs excavated at Thebes must of course be in limestone.

Modern.

Among the modern marbles, the most compact are those referable to the marlites, as being combined with a considerable quantity of argil. The others have seldom attracted especial observation; and the division indeed cannot be regarded as of much importance, as even in geology the granular marbles cannot always be regarded as primitive, nor the earthy as secondary.

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* The African red is often compact.

Most of the compact marbles also contain shells, so that they belong to the next subdivision.

STRUCTURE III. CONCHITIC.

Of Bleyberg. The most beautiful and celebrat
is a recent discovery, being found at : rbe
Carinthia, where it appeared in a bed
limestone, above a vein of lead. It
nately brittle, so that pieces of
be obtained. It is a grey marble, or
stone, reflecting the red, green, and blue
the opal, and almost with equal fire. T
quisite colours arise from the lami
what is commonly called mother l,
kind of nautilus, of which fragments are
in this splendid substance; their lustre
bably heightened by the fine reflections
observable in that of Elba, for veins of
pyrites are not unusual in this stone.

The name of Lumachella, which in Italian simply implies snail or shell marble, now begins to be confined to this, and the following elegant kind.

Lumachella.

Among the numerous marbles discovered in the ruins of Rome, is said to be the beautiful lumachella, ridiculously styled of Astracan, a name which has embarrassed Patrin, who discovered none such in the regions around that city, so celebrated in the Orlando Furioso, and the romances of the middle ages. If he had looked into Ferber or Born, he would have seen that it is a mere corruption, owing to the omission of one letter, the Italian being *Castracana*, not *Astracana*. One kind, according to Born, is called *castracana della astellina*. This is of a yellowish white, spotted with little grey dots*.

The finest lumachella, reputed ancient, is of a deep brown colour, and contains a number of hells, which form little circles, or semicircles, of a bright golden colour, or orange yellow, which appear with the greater lustre from the contrast of he base. This may be regarded as the most singular of all the marbles. Ferber also mentions he following varieties:

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* This Castracan is the Castravan of Woodward and Da Costa: the Khesroan of d'Anville. The mountains of Castravan extend ehind Tripoli in Syria. See Pococke, ii. 92; and Maundrel's Travels. They are also famous for a marlite slate, with impressions f fish and sea-stars: Mode VII.

Greyish brown, with white transparent
like agate.

The same, with rose-coloured st

Brownish yellow, with small b k

With regard to the inferior ki
marble, they seem to have lit
the ancients. The masters t
seated at Rome or Constantinople, c
ten or twelve centuries their
Phrygian, with crimson or lilac rs;
perial red of Africa; the green of
the yellow of Numidia. Among the
lours, a blue alone was wanti
unknown to us, and perhaps to
the sole rock of that colour, being
detached masses; a circumstance as
as that there should be only one shr
flower, and that in our climate c
house.

The artists and dealers at R
with a view of distinction, and
crease the price, may apply the
as jewellers do that of oriental,
more precious kinds. Such perhaps
marble reputed ancient, and c
Panno di morto. Rome *Panno di morto,* or the fu
of the deepest black, sprinkled with
like snails, each an inch or more in

and rather regular intervals. It is very
and deservedly in high esteem. The an-
chio di pavone, or peacock's tail, is by
lled a conchitic marble, the shells forming
rcular and semicircular spots, red, white,
low*.

e modern kingdoms of Europe, as inferior
as in power to the Romans, many kinds of
ic marble have been introduced into archi-
The pillars of the venerable cathedral English.
ham, a monument of the eleventh century,
nstructed of a black marble with white
but both of a dull lustre, the quarries of
are still known to exist at no great distance.
black shell marble there are also tombs in
bey of Melrose, probably from the same
with those of Durham. The marble of the
of Scotland is chiefly primitive.

e black marble, with white shells, is found
ristol, where it is used for chimney-pieces.
ilar, it is believed, occurs in Derbyshire.

Costa, p. 213, says the peacock's eye is a beautiful marble,
ht cinnabar colour, with spots and veins of milk white
ny of the spots form circles about the size of a sixpence,
th a red ground; and which, from an imaginary resem-
ave conferred the name. It takes a high polish, but is
much cracked or flawed. It must not be confounded
pavonazzo, or *purple*.

Purbeck boasts a marble, of which the shells form grey, blue, and white circles.

But the marble chiefly used in our ancient cathedrals and churches, was that of Petworth in Sussex, which is thus described by Woodward:

Petworth.

"*Marble*, from *Petworth, Sussex*. The ground grey, with a cast of green. 'Tis very thick set in all parts of it with shells, chiefly turbinated. Some of them seem to be of that sort of river shell that Dr. Lister, *Hist. Cochlear. Angl.* p. 133, calls *cochlea maxima, fusca sive nigricans, fasciata*. Several of the shells are filled with a white spar, which variegates and adds to the beauty of the stone. That spar was cast in the shell before this was reposited in the mass of *marble*, as is demonstrable from a view of this and other like masses. *Conf. Nat. Hist. of the Earth, part* IV. *consect* 2, *p.* 181, *et seqq. second Edit.* This is of about the hardness of the white Genoese marble.

"The slender round scapi of the pillars of the *Abbey Church* in Westminster, and of the *Temple Church*, are of this sort of marble. So likewise are those of the Cathedral Church of *Salisbury*, as I remember; and my Lord Pembroke assures me positively they are. Some persons that are less skilful in these matters, fancy these *scapi*,

iat occur in most of the larger *Gothick* buildings
f England, are artificial; and will have it, that
ley are a kind of fusil *marble*, cast in cylindrick
ioulds. Any one, who shall confer the grain of
le *marble* of those pillars, the spar, and the
hells in it, with those of this *marble* got in Sus-
ex, will soon discern how little ground there is
r this opinion: and yet it has prevailed very
enerally. I met with several instances of it as I
avelled through England; and had frequent op-
ortunities of showing those who asserted these
illars to be factitious, stone of the very same sort
ith that they were composed of, in the neighbour-
ig quarries. Camden* had entertained the same
otion of those vast stones of Stone-Henge; but
fully refuted by *Inigo Jones*†."‡

Da Costa mentions a black coralic marble,
rom Wales, with madrepores an inch or two in
ength, like half a crown when cut across. It is,
e says, very beautiful, and the tomb of Sir Tho-
nas Gresham, in the church of Great St. Helen's,
s formed of it. He confounds it with the Kil-
enny marble, which he says is much used in Lon-

"* In his Britannia, p. 95.

"† Stone-Henge restored, p. 33."

‡ Woodward's English Fossils, i. 20. The marble of Bethersden
Kent was also noted.

don, and which contains white sparry casts of shells, both turbinated and bivalve*.

The Derbyshire marble, of a pale ash colour, full of entrochi, was much used in London for tables and chimney-pieces†.

Good marble is found in the side of Bowfell, in the West Riding of Yorkshire, being grey, with entrochites: it is manufactured at Kendal, and is in great demand at Manchester and Liverpool. Bowfell is one of the highest mountains in England, and sends waters into both seas. It is about thirty miles in circuit‡.

French.

France abounds in conchitic
red of Givet, containing entrochi,
to the Zoophytic structure. The
Aube shows a grey marble, almost
shells, and some large am
white circles, being transverse sec
from the neighbourhood of Brest. T
in the beautiful red *griotte* someti
aspect§. The greyish brown of I

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* That supposed from Wales is in fact the same with that of Durham, as appears from Gresham's tomb.

† Da Costa, p. 232, &c.

‡ Parkinson, Organic Remains, vol. ii.

§ Brard says that the red spots on the griotte are sh
the outline is marked in black, p. 369: this is from the
of Herault.

lack, with white belemnites, from Narbonne. he black marbles of Flanders. The pearl grey f Nonette in Auvergne, in which the screw-shells re changed into silex, but easily polished.

Italy. In Italy, some churches of Lucca, Pisa, and lorence, are decorated with a brick red marble, ontaining white ammonites. The modern *ochio i pavone*, or peacock's tail, presents round spots, hitish, bluish, or red, being shells cut across. here is also a very pale yellow, with small shells, hanged into white transparent spar.

Spain. Spain offers the conchitic marble of Grenada nd Cordova, of a deep red with white shells; and hat of Biscay, of a deep black, with shells of a plendid white. The pale yellow of Portugal, as lready mentioned, presents marine bodies.

Germany, &c. The marbles of Swisserland, Germany, and the orthern regions, often belong to this description; ut if there were not some striking singularity, it ould be unnecessary to enter much into the specification. Those of Basel have astroites and oralites; of Brunswick, Franconia, &c. belemites, ammonites, and cochlites; of Sweden, ortho- eratites.

STRUCTURE IV. ZOOPHYTIC.

Of this the ancients appear to have made no use, though it sometimes presents varieties at once uncommon and beautiful. A fine kind, *easily had* of the marble-cutters at Paris, is of a chocolate brown, with white madrepores of all sizes and descriptions, beautifully variegated with grey and **Of Caen.** red. This is the celebrated marble of Caen, in Normandy, which may be called the madre marble by way of eminence, and of which b ful tables and other ornaments abound in capital; even those of the traiteur, in the of the Tuilleries, being of exquisite eleg variety.

"The marble of Caen is of a dull red, and it has large veins or branches of a grey or white colour, which are solely composed of madrepores, distinctly perceptible, either in the form of stars, or that of diverging branches. This is then by excellence a madrepore marble.

"Its quarries are in the neighbourhood of Caen, and although it be rather coarse and common, it is much used at Paris, either for the tops of commodes, or for chimney-pieces, &c. There are tables of it in most of the coffee-houses of Paris; and it is known in commerce by the name of Caen ırble. It somewhat resembles that of Lanedoc; but is more cloudy, and less lively in its lour, and does not take near so fine a polish."*

Another singular zoophytic marble occurs in ance, the ground being a wine red, with spots dull white and green; the latter being itself lcareous, which is far from common. It is inrspersed with fragments of madrepores, and her zoophytes, of a delicate bright red. It is obably from the south of France.

The deep red marble of Givet, with light veins spots, contains white fragments of entrochi. hat of Charlemont is veined with white and red, ith white spots of madrepore.

St. Baume.

The beautiful marble of Languedoc, or St. ume, is of a fiery red, mingled with white and ey, disposed in convolved zones. Some say that e white and grey parts are formed by madreres. The eight columns which decorate the w triumphal arch, in the Carrousel at Paris, e of this marble, which is one of the finest of rance.

The grey marble of Mons contains entrochi. is properly an orsten, as on friction it yields a useous smell. The department of Calais furnishes a deep red marble, with grey spots, of zoophytic remains. The marble of St. Anne, in the neighbourhood of Namur, on a deep grey base, presents white zoophytic spots: that of Thilaire is similar; and that of Leff is pale red, with white fragments of madrepores.

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* Brard, 362. That of Canne, here alluded to, is a *griotte* of a ep red, spotted with white, according to Patrin.

The starry marble of Italy is light grey or white, and seems to be entirely composed of zoophytic fragments.

Swiss.

At Roche, a league beyond A e, is
of a handsome marble, veined w red,
grey, and black. It is polished on t
is much used at Geneva, and the I 's
nor is it unknown even at Lyons. P
of this marble present beautiful madr
some shells, chiefly pectenites; but
assumed the nature and grain of t
the shell seldom or never appears
form *.

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* Sauss. 1092.

MODE II. KONITE.

Distinction. There is a stone universally employed in architecture, and which may be regarded as ntermediate between marble and limestone. Freestone. t appears to have been the *freestone* of the middle ages, called *ashler* when only roughly hewn; and is also the freestone of Woodward, and many other writers of mineralogy. Mr. Parkinson has recently confirmed the justice of this appellation, by informing us that "freestone is a compact limestone, of an earthy fracture."

Yet many late writers have inaccurately applied the term *freestone* to a very different substance, using it as synonymous with *sandstone*, chiefly indeed with a calcareous cement; though it has also been extended to the argillaceous, and even to the siliceous. The reason given for the name is, that such a stone may be worked in any direction; nay, Doctor Kidd informs us "that sandstones which yield readily to the chisel, and hence called siliceous freestones, are used in masonry." If the term were thus extended, it might also be applied to granite, which is used in many countries for the commonest habitations. Even calcareous sandstone can scarcely be called a freestone, as it often requires to be placed in the original direction of its layers in the quarry, else it will moulder in the air; which is also the case with some limestones employed in the public buildings at Oxford, and which therefore can scarcely be called freestones.

The freemasons of the middle ages, who appear to have been the successors of the Knights Templars, from their allusions to the temple, the military tinge of their mysterious rites, which formerly excited the jealousy and revenge of monarchs, and other circumstances, appear to have applied the name freestone from a yet more delicate and appropriate circumstance, namely, that it might be wrought into ornaments of the most minute description, such as are observable in the cathedrals and other public buildings, not to mention the crosses, tombs, and other monuments, of the middle ages, which could never be imitated in any sandstone. The little fleurets, and other miniatures, which we admire in the tombs and buildings of that period, are sculptured on a stone of the finest grain, and at the same time of a softness most easily obedient to the chisel; qualities which, if found in any sandstone, it would soon moulder, and he labours of the sculptor would scarcely survive his own century*.

Name.

The original acceptation of the term being hus lost, it has of course become vague, and ught, as in many other instances in the progress of mineralogy, to be exchanged for another, strictly appropriated, and which cannot be abused. As this rock may be regarded as the noblest of the common limestones, and though Greek etymons have become universal in he science, yet the Greek words representing imestone and silex have not hitherto been admitted, the appellation of Konite is proposed rom Κονια, which is used repeatedly for lime by heophrastus, especially in the last chapter of is book on stones†.

Characters.

Konite being merely a compact limestone, of n earthy fracture, sometimes coarse and sometimes finer, for its other characters those of limetone may be consulted. There is sometimes a light admixture of silex, often of argil, rarely of nagnesia, which however has been found by hemical analysis in some kinds, as those emloyed in Westminster Abbey and the Cathedral

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* Calcareous sandstone of course leaves much sand in the nitrous cid; while konite produces none, or, in some kinds, a very small uantity.

† It might also be called *Oikite*, from its use in building. Τιτανος, another term for lime, has been oddly applied to *titan*, a metal.

of York; and that fine earth must
part some of its usual qualities,
ness and durability*. By some lit
might probably be discovered fr
ries the stone used in our cathedr
ancient buildings, was procured.
Of Caen. even brought from Caen in N
as would seem, because it
Norman conquerors. It is said to
posts and lintels of the castle at
in many other places; but the
stone is often erroneously ap l,
in the abbey of St. Alban's;
from authentic records, that the
Tottenhoe. employed was from the quarr
in Bedfordshire. Not contented
jestic appearance of konite, or
stone, on whose soft tinge of br
eye reposes with more pleasure t
tering splendour of marble, our
creased the magnificence with si
pillars of Petworth marble, d
now unknown, near the t of
Sussex. This marble is often i
Purbeck, while it is totally different
lours and composition. The st

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* See the Mode Magnesian Limestone, Domain IV.

tworth marble is even singular, as the shells, iich are very small, seem changed as it were o drops of spar and marble; and the prevail- tints are a faint green and reddish brown; iile in the Purbeck the tints are a bluish grey ash, and a dull yellow or fawn colour; and shells are marked by little black lines. These lars of Petworth marble adorn the cathedrals Canterbury and Salisbury, the Abbey Church Westminster, and that of St. Alban's; not to ention the Temple church, and Great St. He- i's, in London; and probably many others ight be noted. The contrast of this beautiful rble with the konite of the rest of the edifice ist have been striking and magnificent; but present all is equally covered with a white or llowish wash, so as to recall the memory of e whited sepulchre, applied in scripture to a pocrite; while the walls ought only to be eaned, and the pillars polished anew, as in me sacred edifices of the Continent.

Portland stone.

At present the most remarkable konite used the southern parts of England is that of Portnd, which is thus described by Dr. Woodard:

"*Stone* out of the great quarry of *Portland*, a pale or whitish colour, composed of nuerous small roundish grains, not unlike the smaller ova of fishes. They split in the cutting of the stone; so that it is capable of being brought to a surface, very smooth and equal. Besides, this and all like sorts of stone that are composed of granules, will cut and rive in any direction: as well in a perpendic or in a diagonal, as horizontally and par e of the strata. 'Tis for this reason that i obtained the name of *freestone*. T bear the injuries of the weather eq differently in all positions: when that is slaty, with a texture long, par the site of the stratum, will split o ways, or horizontally; and if p d other position, 'tis apt to give way, rt, burst, when any considerable wei upon it. Which inconvenience the stone being not liable to, cutting freely, being of a colour very good and agre made use of for the better buildings about London."*

Da Costa calls the Portland sto sandstone; and, with equal error, s sandstones have obtained the name of because they were cut in any direc subjoins some account of the Surry yegate, and Godstone; which last is said to ave received its name because it was often used n churches. They seem by his account to be oarse sandstones with mica, now chiefly used or ovens and hearths, and the like purposes.

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* Woodward's English Fossils, 1729, i. 17.

Other kinds.

Konite is by the French called *pierre de taille*, *oellon*, &c. The Italian *macigno* seems an rgillaceous limestone with a little mica; while he *travertino* used in the ancient and modern difices of Rome strictly belongs to the calareous tufas, under which it will be described. he building stone chiefly used at Edinburgh, specially in the beautiful new city, is from the uarry of Craigleith, and is said to be an argilceous limestone, perhaps sandstone, with blackh veins. The ancient Romans, whose buildings re alike distinguished by magnificence and dubility, chiefly, like their successors, employed e *travertino*, which abounds on the banks of e river Anio, and is reproduced by its depotions. To the lasting nature of this stone, and f the mortar mixed with puzzolana, which also bounds in the neighbourhood, that is, to cirumstances merely accidental, may the preservaon of the common sewers, and other works of rprising antiquity, be ascribed. But the use f konite in building ascends even to the earliest ges, the pyramids of Egypt being constructed

Pyramids.

with this material; which, as already mentioned, seems the *lapis Troicus* of the ancients. The Egyptian konite, which forms a whole chain of mountains, extending from Cairo and the front of the pyramids, far to the south, is sometimes simple, and sometimes contains shells, chiefly nummulites, which, when cut across, resemble grains of wheat or barley; whence the fable of the ancients, that the workmen employed received such vast quantities of grain, that much of it was left and petrified. Some of the most ancient edifices of Persia, Greece, and Italy, are also built with konite; but the ruins of Pœstum, and the temple of Agrigentum, are of calcareous tufa.

In general, writers on mi r,
are often occupied with l c tri
strangers to the chief object, whi ;
of the substances. Brongniart,
the porcelain manufacture at Sevr
tomed to consider objects as adapt
poses of human life and manners, l
deviated into utility; and his c
konite thus becomes interesting.

Brongniart's account.

" This substance is the *ch*
grossiere of Haüy, and is c ly
à bâtir, *pierre de taille*, and
ture is often loose, and the n c

sily cut with any sharp instrument, but
not receive any polish. The fracture
ranular and dull; as are also the colours,
h are white, grey, and Isabella yellow.
kinds differ greatly in the fineness of their
s, in colours, and duration; but these dif-
ces only influence their use for distinct
oses, and do not depend upon their original
tions.

Some have a very fine grain, and a whitish
ur; but have little hardness, and cannot be
loyed except in sculpture. Such are the
e of Tonnerre, in the department of Yonne;
one of those quarried at Nanterre, near
s; not to mention other examples.

Others have a coarser grain, while their
ur is yellowish; and they are tender and
le. Such are the stone of Conflans Ste. Ho-
ne, near Paris, of which the beds are some-
s two yards in thickness; and that of St.
and Trossy, in the department of Oise; the
s of the latter being only a yard thick.

In fine, others, though of a very loose tex-
, and of a very coarse and visible grain,
ough even composed of calcareous sand and
lutinated fragments of shells, &c. possess
rtheless great hardness and solidity; such
he stone of Saillancourt, near Pontoise, the

beds of which are so thick that the quarry seems cut into one mass. It is reserved for bridges and highways[*].

“ This rock seems exclusively to belong to the depositions of coarse sediment, which are far from the primitive mountains, and which approach the alluvial territory. Although it present beds of great thickness and extent, it never forms mountains, but only round hills, of which the skirts sometimes display pretty high precipices. It forms the base of many plains, such as in France the plains to the south of Paris, those in the neighbourhood of Caen, and others.

“ The beds of this rock are very distinct, being horizontal, rarely inclined, never convoluted nor bent, and commonly divided by clay, marl, or sand. There are sometimes seen, between them, infiltrated geods of quartz and calcareous spar, as at Neuilly, near Paris; or thin layers of keralite or flint, interspersed with shells, as at St. Cloud and Sevres.

“ These beds vary much in thick
may be observed, that they are
soft kinds than in the hard. The
in such thin layers that it is used in

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[*] One stone in the parapet of the celebrated bridge of Neuilly is thirty-four feet in length. P.

es, as in the Cote d'Or, near Dijon, instead of
tes, to cover the houses; and these flat stones
ve received the absurd name of *lava*. This
nestone is often an impure mixture of calcareous
nd and fragments of shells; and sometimes con-
ins entire shells, which are generally of the kind
lled *littoral*, because they are found near the
ores of the sea[*]. The limestone of the neigh-
urhood of Paris is full of great numbers of
ese shells, called *cerites*, or screws, which are
metimes so abundant, that the stone seems
tirely formed of them. There is found at
eissenau, near Mentz, a bed of limestone,
hich is entirely composed of little *limnés*[†], of
e size of a grain of millet seed.

" There are neither veins nor beds of metals
this limestone, which only contains oxyd of
on, either argillaceous or calcareous, in beds or
heaps; it is also said that carbonate of zinc
as been found in it; but of this there is no
roof. Coal is never found in this kind of lime-
one; even silex is rare; and sulphurets of iron
re excluded.

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[*] It may be observed in the catacombs under the city of Paris,
at the shells form layers between the beds, like flint in chalk: so
at the depositions must have been at successive periods. P.

[†] The Linnæan name is wanting.

" But if the differences between the compact and this kind are of little consequence, the geological differences are numerous and important.

" This limestone is employed in architecture; the solidity of some of its varieties, and the ease with which it is wrought, giving it great advantages. It is called *pierre de taille* when it is in large masses, and *moëllon* when they do not exceed four cubic feet.

" It is unequally dispersed, being rare in England, and common in France, especially in the environs of Paris, chiefly to the south of that city, from Sevres to Gentilly. Its beds, which are horizontal, extensive, thick, and continuous, are situated between chalk, which it covers, as may be observed at Meudon, and gypsum, which covers it in some parts. It is separated from the chalk by a bed of bluish potters' clay. To different parts of its beds distinct names have been applied, according to their quality, and the uses for which they are destined. That which is of a fine grain and compact texture is called *pierre de liais* *: it may be cut in sharp squares, and resists the weather; the thickness of its beds seldom exceeds eight inches. The

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* In the common dictionaries, *liais*, and *pierre de taille*, are translated *freestone*. Sandstone is *grès*.

re de roche is as hard as the *liais*, but porous
full of shells; thickness of the beds about
feet. The *lambourde* is a tender stone with
ame grain; the beds being about three feet.
se three qualities, and others which we omit,
often found in the same quarry.

The quarries which furnish the best build-
stone used at Paris, are those of St. Nom in
park of Versailles; La Chaussée, near St.
main en Laye; Poissy; Nanterre; the three
yielding stones almost as beautiful as the
s; of Saillancourt, near Pontoise; of Con-
s Ste. Honorine; this quarry yields the finest
ler stones, sometimes seven or eight feet in
kness; of St. Nicolas, near Senlis, which is
ais; of St. Leu and Trossy, department of
e, which is a soft stone.

The soft kinds are sawed dry, the saw hav-
teeth as that used for timber. The hard
ls are divided by a saw without teeth, by
means of water and pounded sandstone.
that they may not decompose in the air,
y must be placed according to their original
s, for very few will last in the opposite po-
on. Several porous and tender kinds are sub-
to split by frost. The weight varies accord-
to their quality; thus the hard stone of

Meudon is to the tender stone of St. Leu as 24 to 17. This stone being generally impure yields a bad lime."*

This important rock may be divided into two structures; the simple or entire, and that mingled with shells, or the Conchitic. No example of the Zoophytic seems to occur in this kind of limestone, which is of recent formation.

STRUCTURE I. ENTIRE.

Aspect 1. Fine-grained. From Egypt.
From Caen, Tonnerre, and Nanterre, France.
From Tottenhoe, Bedfordshire.
From Portland.

Aspect 2. Coarse. This is often found in the same quarries.
From Saillancourt, near Pontoise, in France.
From Portland.
From Scotland.
Yellow, from Lyons, the chief building stone there used.

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* Brongniart, i. 204.

STRUCTURE II. CONCHITIC.

ect 1. With nummulites, from Egypt.

h cerites, from Paris.

h various shells, from the vicinity of Bath.

pierre de taille used at Marseilles is a con- limestone, of which the quarries are at Cape nne*.

MODE III. LIMESTONE.

characters of this rock will be given in distinct Structures. The combination, as former Modes, is chiefly lime and car- acid, about 40 of the latter to 50 of the r; whence the term carbonates of lime. he Modes differ in minute particulars, as y mentioned.

Carbonates of lime.

s useful rock abounds in most countries. enerally burnt to make lime and mortar; also employed in building, and sometimes king roads, though the siliceous substances re durable and proper for the latter pur-

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* Sauss. § 1517.

Geologic relations.

It is often full of marine shells, and lies
incumbent upon slate or sandstone:
even confounded compact lim th
stone. Patrin has observed that t
deposition was more abundant on
mountains than on their sides, bec
scarcely received, on a hundred
face, the same quantity with ten fat
level summit*. Hence the latter is
insulated and separated from that of
because the thin beds on the sides of t
tains were worn down by the waters; u
summits of the mountains attract c
der the primeval waters they m
the various substances contained in

The calcareous chain of the Pyr
higher than the granitic, c
shells, and sometimes assuming c
called orsten, or swine-stone, a
fetid marble. Such is the su
Perdu, a calcareous colossus, about
in length, and four or five miles in
an elevation of 10,500 feet above
the sea.

Bricias.

Sometimes the calcareous beds on t
slopes have rolled down, and the brol

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* Min. iii. 16.

nts have afterwards been united into bricias, ich are very common in this kind of rock.

Contorted.

[n a softer state these beds have been con- ved, in various contrasted forms. "Saussure es many examples of these heaps of calcareous ls, which are contorted in such a manner as dently to show that they have been bent by : effect of the force which parts of the same ls, in a higher situation, have exerted against :m.

" Among others, he observed this effect in :ee different places, on the borders of the lake Lucerne. The one near the mouth of the uss: 'The bent beds,' says he, 'are of a grey npact limestone; they rise from the lake in ertical position; they then bend towards the ıth-west, and on that side become concave. the north-east, on the side of their convexity, ıollow presents itself.

' On closely examining these beds, they are ınd to be very much broken, and appear to ve been so in the act of bending, and even by ɜ force that bent them.'

"The second place is half a league to the rthward of the preceding, likewise on the bor- r of the lake of Lucerne, on which Saussure led: it is a mountain called Axenberg. 'From ɜ summit to the foot of this calcareous mountain beds are observed in the form of an S, pressed, or of which the bendings are strongly marked. These S's are often rep sometimes in contrary directio d rocks are found between them, s cations are not distinct. When t beds are closely observed, it is f are often broken in the strong n this proves that they were not f l position.'

"The third place is opposite the ec on the other side of the lake: 'It in which the beds, which are nearly below, turn up above and form a C, cavity looks to the N.N.E.: on t the S.S.W. of the C, there is a and what is most remarkable is, t which adjoin the lower branch C themselves to a great distance, tain with regular and horizontal

"From these facts Saussure c these dislocations of beds are pr *foulement*, or repressure, which over each other."*

Calcareous rocks seem to be c rare in Africa, and even in Asia. As

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* Patrin iii. 19.

t are found in chalk, so layers of chert, or ke-
te, appear in limestone; while Lydian stone,
l siliceous schistus, sometimes intersect the
mitive calcareous rock.

Limestone often presents mural precipices, as
the Pyrenees, and sometimes in forms ap-
aching the artificial, as in the circus, towers,
l cylinder of Marbois. The picturesque ap-
rances of Chedder cliffs are on a smaller
le. In the chain of Jura, and in the Py-
ees, calcareous mountains have been ob-
ved, with exterior arrects of 40 or 45 degrees,
ile the interior become more and more verti-
l. Palassou and Pasumot, in their descrip-
ns of the Pyrenees, have observed a mountain
limestone, formed of oval and circular concen-
: layers, which present a most singular ap-
arance. On a smaller scale, as in pisolites
d sinapites, limestone often affects the orbi-
lar form.

Saussure informs us, § 347, that the chain of
ra is calcareous, with the exception of some
v spots, covered with calcareous sandstone.
§ 1937 he remarks contorted beds of compact
nestone, which he says of course must be sedi-
ental, not crystallised, and must have been
ranged by a *refoulement*. Nor has the re-

markable intermixture of comp t l with granular, escaped this great o

The singular rock which conta or sea-dates, is a blackish argil rather of a soft consistence†.

Primitive.

That granular limestone is pri long allowed. Among many mountains of this stone, the stu of Finster Aar Horn, Yungf ı] Shreck Horn, or the Peak of H land, deserve especial com sure has long since observed, t it sents lofty spires, like granite; manifest deposition, must evin is so likewise. It appears betwe mica slate and gneiss, as alternates with common slate. Pri stone is commonly white, dark ir dish brown, and is not always g sometimes compact. It sometimes place of quartz in mica slate, and felspar in granitoid, and a rock of

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* Sauss. 2226.

† Id. 1356. On the coast of Aunis, near called *gryphites* are forced into the mud by soon becomes a hard stone, and is called the s Mem. Acad. de Rochelle, tome iii.

re. It is rarely metalliferous, but in Si- t presents rich mines of copper, and in America veins of gold and silver. It is able, that in limestone the shells retain riginal form, while in clay slate they are essed; a circumstance ascribed to the ubsidence of the latter. Caverns are sel- ound except in limestone, the rock being nly eroded by a stream of water.

Formations.

Wernerians regard limestone as of three ions; the primary, the transitive, and the flat or horizontal. The second often ns coralites and madrepores; but Faujas d a madrepore in Carrara marble, which emed primitive.

estone seldom or never occurs pure, there generally a small admixture of argil, mes of silex, sometimes of iron. When is manganese it forms a more tenacious .

STRUCTURE I. GRANULAR.

ect 1. *Common.* The characters mostly ond with those of marble; but the mode bination must vary, as it is not capable of a polish.

colours are white, grey, black, reddish, and yellowish. A green tint may be sus dicate magnesia.

Granular limestone often belongs to kinds or marbles; it is also often soft, light, and coarse, when it falls o this vision.

Grey granular limestone, with calcareous spar, from Lusatia.

The same, mixed with slate, from Saxony.

Reddish brown granular limestone, with slate, from the same.

White granular limestone, from

Chinese tablets.

White sparry limestone, in thin s gles, from China. "There are bro China," says Born, "tablets of an form, often marked with Chinese letters; polish, and sold as artificial, under the rice stones, being regarded as c of reduced to a paste; but the ex r c and chemical analysis demonstrate that it a sparry limestone, cut in these for ' A e fabulous idea concerning rice has been with regard to iconite,

Argillaceous limestone, which into lentiles, convex on both sides, seem to be a bricia were not the homogenous. Sauss. § 1377.

estone, containing large shells full of
auss. § 284.

2. *Micaceous.* Primitive granular lime-
often interspersed with mica, and some-
th orbicular crystals of quartz. It has
een observed, that the mere mixture of
never be understood to alter the deno-
of the stone.
eous limestone, from the Alps.
ame, from the Grampian mountains, in

ıbstance called Cipoline marble is often
as rather to belong to this division.
tone, with nodules of mica and of sand,
Pyrenees.
aceous limestone, in which the mica is so
t that the calcareous mixture is scarcely
shable. Sauss. § 1811.

STRUCTURE II. COMPACT.

re, compact, generally massive and earthy, **Characters.**
s schistose.
ess, from the gypsic to the marmoric.
, fine scaly, sometimes large and flat
al, sometimes uneven. Fragments, amor-
ther sharp.

Lustre, dull. Opake; but often translucent on the edges.

The most common colour is grey, of various tints, and yellow of different shades. It is often veined and spotted in various forms.

Primitive compact limestone, from the Alps.

The same, from the Grampian mountains, Scotland.

Primitive limestone, with garnets, from the Pyrences.

Grey compact limestone, intersected with granular, from the Alps.

Black compact limestone, intersected with chert, from Derbyshire.

The same, with spots of bitumen. The black colour often arises from the bitumen, as appears from the stones becoming white when calcined.

Limestone, of a dull white colour, from Port Rush, in the north of Ireland. This stone, which has sometimes been called chalk, supports the celebrated basaltic columns around the Giants' Causey. It abounds with fossile remains, and nodules of dark flint: for the depth of sixty feet under the basaltin it is impregnated in a singular manner with small particles, mostly oval, of the basaltin; and, from the mixture of colour, is vulgarly called *mulatto* stone. A most singular geological fact.

r. Kirwan mentions a sky-blue limestone,
Aberthaw, in Glamorganshire. But this,
the blue marble of Narbonne, or the blue tur-
appears to be only grey. Dr. Kidd de-
es it as light blue, or grey; and says, that it
mmon in Somersetshire, and that it only
rs in the form of shingle, or large pebbles, on
ea shore at Aberthaw. This colour seems to
ate a mixture of iron; and such limestones,
calcined, become of a buff colour, and fur-
a harder mortar than any other.

STRUCTURE III. CONCHITIC.

any of this description belong to the noble
sion, or marbles, not to mention the konites;
many also are of a soft and coarse nature,
ce they fall under this Structure. The lime-
containing shells is generally grey, but some-
s dull white, or brown. Sometimes even
s are found in limestone, and in marble; and
as, as already stated, has recently observed a
rkable example near Verona, where a fine
k marble, containing petrified bones, is worked
large columns. Karsten, as quoted by Gme-
has also mentioned a limestone, containing
s, which is found at Erfurt; but the pieces
to be small and detached.

Shells.

To enumerate all the shells contained in limestone would be infinite; nor have such as occur in rocks been hitherto carefully distinguished from such as are found detached and scattered. It will be sufficient for the present purpose to mention such as are generally inherent in large masses of limestone, konite, or marble; thus forming, as it were, a constituent part of these rocks. This subject will be further illustrated by the plates.

It has been observed as unaccountable, that the shells of those fish which are called Pelagic or Oceanic, as inhabiting the unfathomable depths of the ocean, are often found at the greatest elevations; while those which approach the less profound depths, and even the shores, are rather found on the skirts and lower hills. If this observation be exact, the explication seems very difficult, except perhaps that, under the chaotic waters, the proper purity and temperature to support animal life could only be found at such elevations.

The shell venerated as the most ancient, and unknown in modern conchology, is that called the *Cornu Ammonis*, or horn of Jupiter Ammon, from the twisted horn, a symbol of power in the images of that deity. In the middle ages they were supposed to be petrified serpents, and sometimes fraud has cut out heads, being esteemed emorials of the miracles of saints. If they xist at present, they are said to be found opic in the Adriatic sea; but a contorted of nautilus has often been confounded *ornu Ammonis.* The petrified are styled nites, the Greek termination in this and er shells marking their stony nature. Am- s occur of all sizes, from half an inch in r, as those which form the singular Dor- marble, to six feet, or the size of a coach- as some have been found immersed and ed into chalk at Margate.

nummulites, or porpites, occur in the lime- f Egypt and of France, being thin shells, er movable opercules or covers to protect hell-fish. Belemnites*, another embarrass- m, are generally found detached. Entro- or joints of the sea-star, are very common. crinites, other joints, resemble lilies.

roceed to the UNIVALVE shells: nautilites in many limestones and marbles; and nes retaining their original lustre, impart

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aps these may be spines of a large pelasgian sea-urchin. ite has at last been observed alive in the South Sea. See us plates to the voyage of Peron, Paris 1808, 4to.; where nd interesting delineations of the zoophytes and mollusks ew and striking.

singular beauty to the opaline marble of Carinthia.

Lituite.
Orthoceratite.
Conite.
Buccinite (Trumpet).
Bullite or Globosite.
Turbinite (Screw-shell).
Dentalite.
Patellite.
Cochlite (sea-snail).

Among the BIVALVES:

Solenite (Razor-sheath).
Tellinite (Limpet).
Dionite (Venus) Dione.
Aphrodite and Hysterolite.
Chamite (Clam).
Pectenite (Scallop).
Ostracite (Oyster).
Anomite (Gryphite).
Mytelite (Muscle. Mya.).
Pinnite (Naker).

The chief MULTIVALVE shell observed in a state of petrifaction is Lepadite, or Balanite.

Several crabs, &c. are discovered apart: and a beautiful little tortoise in flint was found by my friend Mr. Knight, upon his estate of Milton, in mbridgeshire, being, it is believed, an unique mple.

Echinites singularly abound in the chalk-pits of gland, with cockles, &c.; but they are easily arated, and of course foreign to the present rpose.

Limestone, with ammonites, from Dorsetshire.

With belemnites, Thuringia. They may per- s have been mistaken for bones.

With orthoceratites, Erfurt.

With nautilites, Upper Austria.

With strombites, Jena.

With cochlites, Norway.

With chamites, Mont Martre.

With gryphites, Alsace.

Numerous other examples might be added.

STRUCTURE IV. ZOOPHYTIC.

Zoophytes, including the mollusks, also abound common limestone. They are of many varie- ; as the turbinated, the porpite, the fungite, astroite, &c. Among them may also be ssed the milleporite, the celleporite, the entro- te, either in many or single joints, and of several ieties, the gorgonite, the coralite, and the en- nite. The trochite is a word used by some for gle joints of the entrochite, which can scarcely be distinguished from those of the encrinite, rarely marked by the lily at the summit.

Limestone, with nummulites, from Egypt.

With entrochites, Derbyshire.

With madreporites, from Gothland.

Numerous other examples may be added, from all countries; exclusive of the mere calcareous petrifactions, which are found slightly adherent or apart.

STRUCTURE V. PISOLITE.

This kind is so called from its appearance, resembling conglomerated peas; and is chiefly brought from Carlsbad in Bohemia, where it constitutes a large bed. It is of a yellowish white; and the imaginary peas are in elegant concentric layers of white and brown, formed around a grain of sand, like pearls in the shell. Cronstedt has with some propriety ranked it among the sinters or depositions.

STRUCTURE VI. SINAPITE.

In this the orbicular accreti
than in the former; the structure quite
and more compact. The name is deriv
mustard seed. Some call it *meconite*, fr
seed of the poppy; while others use the

lite, from the eggs or roe of fish: but as this ap-
llation might imply that the grains equal the
gs of birds, it is ambiguous; not to add that,
the substance was really supposed to be the
trified roes of fish, whence the English roe-
one, it is better to dismiss a term leading to erro-
ous ideas. The analogy between pisolite and
apite is also preferable, both being derived from
e vegetable kingdom.

This substance is far more abundant than piso-
e. According to Gmelin, it is frequent in the
ratified mountains of Gothland, Saxony, Thu-
ngia, Brunswick, France, Swisserland; forming
nple and often repeated strata, of a dull grey or
own colour; and sometimes, though rarely, pre-
nting animal remains.

The Ketton stone of Rutlandshire is a fine ex-
nple of this kind of rock.

Sinapite, from Iceland.

The same, from Ketton.

The same, of a still finer grain, from Bath.

The same, from the various countries mentioned
Gmelin, where, as it forms vast beds, it cannot
classed among the depositions.

MODE IV. ALABASTRITE.

Ancient. The substances called *alabast*
bastrites by the ancients, are well
merely calcareous, as they efferv
trous acid; whereas the moderns
the name of alabaster to quite
stance, impregnated with the
that the nitrous can produce effect.

The classical writers of antiq
quently use the word *alabastrites*
bastrum; and it seems therefore far
to retain the former name for t
baster, than to apply it with
modern. In general it is dist
yellow colour, especially menti by
and often by brown stripes, arisi
cessive depositions, with some r
the layers of the onyx, whence t x
and pavements of the ancients. F
is acknowledged to be a mere
superincumbent rocks of marble; and,
lactite and stalagmite, forms the *sinter*
Germans; while alabaster is an original
and is even found primitive in the Alps.

Of this remarkable substance, so well known

Roman luxury, Pliny gives the following ac-
unt. "Our ancestors thought that onyx was
ly produced in the mountains of Arabia, and
no other region; but Sudines adds Carmania*.
t first only drinking vessels were made of it;
ut afterwards the feet of beds, and even seats.
ornelius Nepos says that it was reputed a great
onder when P. Lentulus Spinter displayed am-
horæ of onyx as large as Chian casks; yet five
ears after he saw columns thirty-two feet in
ngth. But from more refinement in the choice
f this stone, four columns of a middling size,
laced by Cornelius Balbus in his theatre, were
steemed monuments of surprising grandeur.
Ve have seen more than thirty in the dining-
all which Callistus, well known by his power
mong the freemen of the emperor Claudius,
had erected at great expense.

"Some have called this stone alabastrite; and of it little pots or boxes for ointments are formed, as in them it is supposed to be less liable to corrupt†. When calcined it is also used for plas-

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[*] So Brotier's edition: some read Germany.

[†] Hence the name, which implies what cannot be taken hold
f; because, as commonly supposed, these little pots had no han-
les. But may it not imply the slippery smoothness of the pot or
f the stone?

Nardi parvus onyx. HOR.

ter. It is produced towards Thebes
and near Damascus in Syria; but
white, and little esteemed. The
Carmania, the next from India,
sort is also found in Syria and
The worst, and without any sple
of Cappadocia. They are chi
when of a honey yellow, with orb
and little translucent. It is esteemed
value when of a horn colour, or white,
glassy appearance."*

Pliny then mentions that the L

Alabastrum seems to have been more gene
times: *cum alabastris unguenti*, says the author of the
to Petronius Arbiter; and who has deceived all the critics,
surely flourished about the time of Elagabalus;
is directed against the manners, and not Nero, or
person. The learned reader may consider the of
p. 211, edit. 1669, and may compare many other
Historiæ Augustæ Scriptores, which form the best
this strange work. See also the arguments in
driánides, or Hadrian de Valois, which indica
Statius, and refers this satire to the age of Gall
for villas, used by this author, is first introdu in
Apuleius.

Alabastrum is also put absolutely, by other wri
alabaster, commonly used to contain ointment.
the feet of Jesus was in "a box of alabaster." John xii.
other evangelists. It was a sacrifice of her toilette by
dalen.

* xxxvi. 12.

Paros was next in esteem for preserving oint-ents; and it is probable that this name did not tend, as is supposed, to the marble of Paros in neral, but was confined to stalactitic portions und in certain cavities. Though this sub-ance be merely an infiltration from surround-g rocks, yet it sometimes fills immense caverns, that tables may be seen in Italy, and some en in England, of eight feet by four; being itire slabs of the most beautifully veined ala-astrite, commonly called by the artists oriental abaster. The veins seem to be chiefly of a rruginous nature. When iron is absent the ibstance may remain of the purest white; as ie grand and singular depositions in the well-nown grotto of Anti-Paros, one of the wonders f the world. But this pure white kind, being f a very soft and fragile nature, was little steemed by the solid taste of the ancients; and seldom used even by modern artists, except minute and trifling ornaments. The yellow id veined kinds, on the contrary, are hardened y the presence of iron, so as to scratch marble, hich may also be done by portions of the hite, as the softness rather arises from the lax-y of the grain, probably from the want of com-ression.

Modern alabastrite.

In modern times alabastrite, equal to the ancient, with brown veins, has been fo pieces at Mont Martre, near Paris; t Spain are in rocky masses, and of gr It is said that the territory of Volter cany, affords no less than twenty varieties*.

Of Volterra. "Those most esteemed are the ters, to which this name is given, their fineness; and the onyx present clear and distinct layers, lours, all of them undulated and saliant and re-entering angles, like t of fortification-agates, and of which forms a figure nearly circular. Tl of these zones is owing to a of c lisation, like that of agates; and lil they are always found exactly themselves, whatever may be in of their course. A perpetual cir place in the interior of the alab still in its native site, which arra particles of which it is comp laws determined by their mut

"The onyx-alabaster sheets on a horizontal p ;

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* Patrin, iii. 110. In the catalogue of Davila, ii. observed that the ancient alabasters were probably the same sorts abound there.

instead of forming re-entering courses,
e straight lines, or slightly undulated;
these layers are of lively marked colours,
s the white and red, cameos may be made
n, as they are of onyx-agates.

he onyx-alabaster of Sienna is of the ut-
beauty: it presents layers of three bright
stinct colours; yellow, red, which is opake,
hite, which is very transparent.

he other alabasters of Italy, which are
aluable, are the agate-alabaster of Sienna,
is nearly transparent, and of a fine uni-
ellow.

he alabaster of Montanto, in Tuscany,
is yellow, semi-transparent, with undu-
white veins.

he alabaster called *Pecorino,* which is
arent, of a uniform fawn colour, or min-
ith brown veins.

he isle of Malta also furnishes various ala-
s, and particularly one of the colour of
ike the agate-alabaster of Sienna; its paste
the greatest fineness, and of a beautiful
transparency. In the Museum of Arts is
statue of Minerva, nearly as large as life,
imilar alabaster, which is much admired.

he name of oriental alabaster is given to
hich adds to a fine paste lively and distinct

colours, and a hardness which renders it susceptible of a fine polish. In general, the denomination of oriental stone implies less the native place of the stone, than its intrinsic value; thus in Italy and France alabasters are found which deserve the epithet of oriental.

“ The celebrated sculptor Puget
near Marseilles an alabaster, so transpar
the eye could penetrate into the inter
substance; and, to the depth of
trace the beautiful tints with which it
loured.

“ Guettard says that the waters
Provence, form a deep-brown alabaster,
with whitish zones, which make it
the oriental kind. This alabaster
an ancient conduit, built by the R
brings the water from a spring
league from the town.

“ This aqueduct was entirely
beautiful alabaster, which pre
layers, of about a line in thickness. T
found by the lens to be composed
number of very thin plates; and
formed a solid compact mass, hard
take the finest polish.

“ At Montmartre, and in the
plaster-stone in the environs of

cially at Lagny, a substance is found, which at irst view resembles a fine oriental alabaster: brown zones of different tints, on a lighter base, are in like manner observed in it; they are undulated, and parallel to one another, and produce a most pleasing effect. But this pretty tone is only a stalactitic gypsum, which takes ut a slight polish, and much less brilliant than hat of real calcareous alabaster*."

Yellow clouded alabastrite, from the ruins of Rome.

Veined alabastrite, the onyx of the ancients, rom the same.

A noble column, about twenty-four feet in height, was found near the Appian way, and placed in the library of the Vatican; perhaps he same which is now in the Museum at Paris.

Veined alabastrite, white, with reddish yellow veins, from Andalusia, Spain.

Veined alabastrite, from different parts of Spain.

With mazy veins, light yellow and brown, rom Malaga. This has furnished many decorations for the palace at Madrid.

Mazy alabastrite, of a deep brown, with lighter eins, from Sagena, in Sicily.

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[*] Patrin, ib.

With veins of a lively red, mingled with yellow ones more or less deep, from Montreal, in Sicily.

With yellow and black veins, from Mount Pellegrino, in the same country.

Yellow, veined with white; and another, with black, brown, and white mazes, from Malta.

Fiorito. There is also a kind of alabastrite which the Italians call *fiorito*, implying that it is marked with irregular spots, faintly resembling flowers. Two columns of this kind, very rich in colours, which however he does not specify, are placed, according to Brard, in the Napoleon Museum at Paris. They were discovered, in 1790, in the ruins of Gabium, four leagues from Rome. It is probably with this kind of alabastrite that Strabo compares the Synnadic marble, when he says it is variegated like alabastrite; but perhaps he means its light aerial appearance, whence the poet of St. Sophia compares it to roses sprinkled on white air.

For the common or modern alabaster, the reader is referred to Mode X., which follows Gypsum.

MODE V. LIME-SLATE.

Distinction.

e marbles, konites, limestones, and alabas-
are so important in many points of view,
hough this kind chiefly differ in the struc-
rom limestone, it was thought advisable to
t a distinct division, especially as the mode
nbination is really different, for, not to men-
he micaceous kind, it is more abundant in
han the massive limestone. Lime-slate is
lcareus fissilis of Wallerius; but the foliated
one of Werner is so called only from the
re.

ne-slate sometimes presents alternate layers
erent colours; such as white and reddish,
vhite and greenish; both of which are
at Dannemora, in Sweden. It sometimes
ates with keralite or chert, sometimes with
late, sometimes with marl-slate. Some
ar marbles, of which the veins are quite
hed, and uniform, probably belong to this
n. The cipolin also sometimes, though
, appears in level layers, divided by foli-
s mica*.

---

ie whole isle of Garbolach, Hebudes, is said to be composed
slate, or what is called *marble flag*.

Mont Cenis.

Saussure observed many mountains in the Alps chiefly composed of what he calls micaceous limestone, often alternating with mica slate. The following observations occur in his description of Mont Cenis, celebrated for the passage into Italy.

"Soon after is observed the mi
tus, which really forms the body of t
tain, but which is also found in
covered with tufas. These schisti c
careous earth, with a granu
aspect, such as it assumes in
tains: it is even in such quantity
schisti strongly effervesce with the
and become friable, after having ren
time in it.

"It will be seen hereafter that
and mica are found at Mont Ce
all proportions; from limesto
which only a few plates of mi
to the micaceous rock, which c
no free calcareous earth, and in
supplies the place occupied by the
the former. There is nevertheless
able circumstance in the schisti of
that those which are calcareous
free from quartz, as is proved by tl
may be almost always obtained from it

nd in like manner quartzose micaceous schistus s seldom found which does not yield some bubbles in acids, and which, reduced to powder, does not lose some of its weight in distilled inegar.

"These micaceous calcareous schisti are not ommon. Those authors who have written systems of mineralogy have not known them, or at least have neither classed them, nor given them ames in their works. I have described, in the second volume of these travels, § 996, those which I discovered in the valley of Aosta in 778; but in them the free calcareous part is never predominant, it forms at most but the ourth part of the rock. Those of Mont Cenis differ also in the colour of the mica, which is of an iron grey, or verging to blue, while that of the valley of Aosta is white or yellowish.

"The first rocks of this kind, which are met with above Lans-le-Bourg, have very thin and very fragile plates: they rise to the E. S. E., under an angle of twenty degrees; higher, after having crossed a little bridge, the same schisti are found in an opposite position, or rising to the west. But this position is accidental; it may be said that in general they rise to the E. S. E., following the slope of the mountain."*

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* Sauss. 1234.

Other sites. This micaceous lime-slate was afterwards observed by our excellent author at the little St. Bernard; and at the Roth-Horn and Mont Cervin, two mountains near the celebrated Rosa, chiefly composed of serpentine.

The subsequent detached observations may also be added from the same treasure of orological knowledge.

Near Morges the mountains are
with undulated veins mixed with
a fine cipolino. The roofs of the
vered with thin plates of the

A bed of primitive lime-sla
gneiss. It is six feet in thi
layers, of about half an inch,
some infiltrated green matter.

A lime-slate, analysed, which is i
granite.

Roche Michel, near t (
of a mixture of calcareous
ish talc, the latter being pred

Aspect 1. Micaceous lime-slate.]
Cenis. From M. Cervin, and other
Alps.

The same, from Canada, North A

A micaceous lime-slate, the

---

* Sauss. § 950, 2225, 872, 1262.

granular and brilliant, as it appears in primitive mountains. Sauss. § 1234.

Aspect 2. Common lime-slate. From Gibraltar.

In layers of different colours, from Sweden.

With chert, from Derbyshire.

A fine lime-slate, of a bluish grey, the leaves being very thin and inseparable. Sauss. § 2047.

A lime-slate, with quartz and mica, near Ville Neuve, on the river Doire. Ib. § 955.

Dr. Kidd has given the following interesting account of a quarry of this kind of stone, if he has not mistaken calcareous sandstone for limestone, a mistake which not unfrequently occurs. He calls the substance calcareous slate, or flag-stone; while the latter name is commonly applied to a schistose sandstone, either calcareous or argillaceous. The limestone of Pappenheim, in Germany, rises from the quarry in thick tables, serving at once for pavements, gravestones, or similar purposes, and certainly belongs to this kind, as must the following, if Dr. Kidd's description be exact.

Quarry of Stonesfield.

"There is a very extensive quarry at Stonesfield, near Woodstock, the limestone of which has the property of being easily separated into laminæ by mechanical means, or even by the action of the atmosphere. The manner in which the effect is produced in the latter instance may be understood by a reference to what was said respecting that superficial disintegration which takes place occasionally in calcareous free-stone.

"This variety of limestone is employed very generally for the purpose of covering the roofs of houses; whence it has been called *lapis tegularis*. The property of being thus easily separated into laminæ depends partly upon the proportion of clay contained in it (for this property is in general more remarkable in proportion to the quantity of clay contained), and partly upon the nature of its original deposition; for the stone of some parts of the quarry contains a considerable quantity of minute shells, resembling millet seeds; and it seems worth observation, as connected with the schistose property of the stone, that the deposition of shells is more abundant on the surface than in the substance of the laminæ.

"In some instances a singular arb
pearance is observable on the contiguous
of adjoining laminæ: the colour of this is
most part black; and, from some expe
that were made for the purpose of ascer
nature, appeared to be principally n
The same appearance is observable in s
ties of Florentine marble. Sometimes

s only superficial; at others it penetrates far into he substance of the stone. The explanation of he appearance is not obvious; but perhaps some quid, holding the colouring matter in solution, riginally insinuated itself into the clefts by which he laminæ are separated from each other, and eposited this, particle by particle; by something ke that continuous attraction, if the term is llowable, which takes place in the freezing of noisture on a pane of glass."*

MODE VI. CORAL ROCK.

The texture resembles clustered corals, or nadrepores, cemented by limestone†.

Origin.

This substance has not yet been mentioned in ooks of mineralogy, though large islands and ast shoals in the South Sea, particularly on the ast of Australasia, are wholly composed of it, ccording to the accounts of navigators. Coral itself is now known to be the gradual structure of minute insects, which thus surpass all the powers of man; for the locust can spread more destruction than an Attila, a Timur, or any other conqueror: and a beneficent monarch can only found a city; while insects almost invisible found islands, and even continents, the scenes of future glory and misery to mankind.

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* Vol. i. p. 31. See also Da Costa, p. 144, who adds, that a imilar slate is found near Bath. The white flag common in the orth of England he ranks among the alkaline calcareous sandtones: it is spangled with mica, sometimes very prettily, especially at with little needles, lying in a diagonal form.

† The characters of limestone apply to many of the rocks in this omain, and are therefore not repeated. The characters are also ometimes implicated in the descriptions.

Whether these insects produce
coral, or imbibe it from the w
these islands rise from a sur
when they surpass the waves, n
lichens and mosses; which, de
ting, afford a soil for other sn veg
by degrees reeds, shrubs,
decorate the new creation. T
being fertile, these islands will in
centuries invite colonies, whose f
ogists may perhaps be embarrassed
for their native rocks; which n
fer benefits on agriculture
for zoophytic marble will not
the construction of their edifices.

Rocks of a somewhat similar
near Sutherland, on the eastern c
and near Peterhoff, at the fur
the Gulf of Finland. This sing
seems composed of tubes of ma

often with open intervals; and at Sutherland is the common building-stone.

Coral rock, from Australasia.

Madrepore rock, from Sutherland and Peterhoff.

MODE VII. MARLITE.

Description.

The combination of this substance is the same with that of marl, the calcareous earth being mixed with a considerable proportion of argil. Some marbles, which contain from 15 to 30 or more of argil, are properly marlites; and they are apt to decompose in the open air. Such is the green Campan of the Pyrenees, which also contains a considerable proportion of magnesia. Several of the Russian marbles also contain clay, but mixed with a still larger proportion of silex.

The celebrated pictorial marble of Florence, which imitates ruins, and sometimes trees, is properly a marlite.

Marble of Florence.

"This marble presents angular figures of a yellowish brown, on a base of a lighter tint, and which passes, in diminishing, to a whitish grey.

"Seen at a certain distance, slabs of this stone resemble drawings done in bistre. One is amused to observe in it kinds of ruins: there, it is a Gothic castle half destroyed, here it presents ruined walls; in another place old bastions; and what still adds to the delusion is, that in these sorts of natural paintings there exists a kind of aerial perspective, which is very *sensibly* perceived. The lower part, or what forms the first plane, has a warm and bold tone; the second follows it, and weakens as it increases its distance; the third becomes still fainter, while the upper part, agreeing with the first, presents in the distance a whitish zone, which terminates the horizon, then blends itself more and more as it rises, and at length reaches the top, where it sometimes forms as it were clouds.

" But approach close to it, all vanishes immediately, and those pretended figures, which at a distance seemed so well drawn, are converted into irregular spots, which present nothing to the eye.

" This play of nature is owing to ferruginous infiltrations in the fissures of this marble, which otherwise is of a dull fracture, and very argillaceous; whence it is never used in architecture; they merely make slabs of it, which are framed like little pictures, and which are much esteemed in commerce when of certain dimensions. It sometimes occurs that the same slab is sawed in two, and the parts are set together in the same rame, so as to appear but as one piece; and the drawings on the right and left bear a resemblance, which still farther helps the illusion. There are some, who, to out-do nature, put painted figures at the bottom of these pictures; but this is an exuberance of the wonderful, which finishes by spoiling all."*

Of marlite there are two structures, the massve and the schistose.

STRUCTURE I. MASSIVE.

Aspect 1. Argillaceous marble. Green and red of Campan; but which, from their structure, rather belong, at least in part, to the Anomalous Rocks.

The reddish of Ingermania, &c.

Aspect 2. Pictorial marble. This is said to be massive, though it would rather appear to be schistose. The marble of Cottam probably belongs to this division.

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* Brard, 415. The marble of Oker in the Hartz is white, with regular veins of black clay slate; and may be classed in this division. Jour. des Mines, No. 23, p. 73.

The marlite of Shropshire, called *dye-earth,* more than 100 yards thick, contains small bivalves, and what are called the Dudey fossils, the *entomolithus paradoxus* of Townson. See his Tracts, p. 165, 177.

STRUCTURE II. SCHISTOSE.

Substances in this state generally present a finer grain than when they occur massive. Marl-slate sometimes presents delicate concentric circles, and other delineations, of a light brown upon yellowish grey, its usual colours.

Impressions of fish.

But it is still more remarkable, as being the general repository in which are found the remains and impressions of decayed fish. In this case it is commonly penetrated with bitumen, probably derived from the decomposition of their bodies, as chemists now infer that substance to proceed exclusively from the animal or vegetable kingdoms. Da Costa mentions that of Mount Lebanon, near Tripoli *di Soria* (of Syria), in the province of Castravan*.

The slate, with impressions of fish, from Eisleben, Ilmenau, Mansfeld, &c. were formerly celebrated, and the animals are often delicately delineated, as it were, in cupreous pyrites. At present those of Mount Bolca, in the Veronese territory, have attracted more attention; and the proprietor has filled a whole chamber in the museum of the Garden of Plants with these singular

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* P. 170. This is the Khesroan of D'Anville, and the Castravan of the Italians, whence the celebrated lumachella.

ains. The mud and poisonous vapour, per-
s of a volcanic origin, seem to have surprised
destroyed these animals almost instantane-
ly, for most appear to struggle, and one is in
act of swallowing another.

aussure has described similar quarries near
, towards Lambesc, in the south of France,
ch also present impressions of leaves of palm-
s. The same great observer has added an
ount of that of Oeningen, near the lake of
nstance, which first presents a thin layer of soft
aceous sandstone, cemented by clay and lime;
ther of coarse marl and marl-slate, followed
lime-slate, alternating with layers of clay. At
depth of nine or ten feet appears the rock,
ich contains the impressions; and which is, as
al, a bituminous marlite. The fish are accom-
nied with several insects, and leaves of trees,
ne of which belong to warmer climates; but
from being so extraordinary as those of Mount
lca, which, not to mention more recent dis-
eries, presented at the time when Saussure
ote, 1795,

27	kinds of fish of the European seas.
39	. . . of the Asiatic.
3	. . . of the African.
18	. . . of South America.

11 kinds of fish of North America.
7 . . . of fresh water of the different parts of the world.
——
In all 105.

MODE VIII. ORSTEN.

Name, Swedish.

Some of the Swedish appellations ought to be venerated, as that country has produced such able writers in natural history, and particularly in mineralogy; of which science Wallerius, Cronstedt, and Bergman, must be esteemed as the chief founders. The substance now under view has by some of our mineralogists been called *swinestone*, and by the Germans and French less politely *stinkstein*, and *pierre puante*; but as the Swedish name has more brevity, and does not impress a disagreeable idea, it deserves to be substituted.

Description.

Orsten is merely a limestone,
times from a mixture of bitumen,
from yet unknown causes, yields a
when worked in the quarry, or in
yards, or even when rubbed with any
stance. In a geological point of view, it
assumed higher consequence, since it was

red by Ramond to form the summit of Mont u, the highest of the Pyrenees. It is gene- of a black colour; but some specimens Derbyshire are even white, or at least sh grey. The other tints are chiefly va- greys, with brown and Isabella yellow.

r. Kirwan says that the smell is urinous or ious; and that it abounds in the county of ay, in Ireland, where, as fuel is scarce, it is employed to heat the rooms, and remains or many hours. In the neighbourhood of vius it is found laminar, alternately white ellow. It often produces excellent lime.

Used as fuel.

grey Flemish marble, now much used at , belongs to this kind, and leaves a very smell in the manufactories. That of the it of Mont Perdu is a black marble, im- ated with shells and sand. Ammonites amerines, gryphites, pectenites, with mad- es, and other zoophytic remains, enter into omposition of the singular calcareous chain Pyrenees.

ick orsten, from the summit of Mont Perdu.
ey, with zoophytic remains, from Flanders.
yellow and white plates, from Vesuvius.
eyish white, from Derbyshire.

MODE IX. GYPSUM.

Characters.

Texture, coarse-grained and loose, co
with a saline or crystalline appearance.

Hardness, of course gypsic. Fracture, uneven. Fragments, amorphous, blunt.

Weight, granitose, sometimes only

Lustre, glimmering. Opake.

The colour of that of Montmartre is
ish brown; but it is also found of
of grey: and is sometimes so
resemble coarse limestone.

As gypsum and alabaster con
peculiar ingredients, though
mode of combination, it may be
by considering them on a large
one point of view.

In the language of modern ch
and alabaster are sulphates of
phuric acid forming about half
sition, as the carbonic does in
careous rocks: hence the
do not effervesce with nitr
rious descriptions of limestone*.

---

* Fluor very rarely forms rocks; but with Phospha
found in the Anomalous division.

The distinction between gypsum and alabas-
r may be regarded as more wide than that be-
veen limestone and marble, though chemical
riters arrange alabaster as merely a compact
ypsum; but the artist, and the antiquary, and
ven the common observer, consider alabaster as
distinct substance.

As limestone may be called a coarse marble,
id when calcined forms lime, so gypsum may
e regarded as a coarse alabaster, which when
alcined forms what is called plaster of Paris,
ecause the best is made of the gypsum of
Iontmartre, in the neighbourhood of that city;
nd the alabaster of the moderns, or compact
ulphate of lime, has, like marble, been em-
loyed by the sculptor and the architect, being
f a fine grain, and of a whiteness which has
ecome proverbial. The tombs of the middle
ges are sometimes of alabaster, yet more gene-
ally, it is believed, of alabastrite; but this has
eldom been examined; for while every parish
as its antiquaries, we have few mineralogists.

Some kinds of gypsum and alabaster, as the
arthy and fibrous, with the crystallised, called
elenite or moon-stone, as it somewhat resembles
he gleam of the moon in water, are found in
eins and nodules, and belong to lithology. In
iterary composition, as in painting, the eye

should repose on large masses or divisions; while minute and broken lights only distract the attention and the memory. The gypsous rocks may safely be reduced to two kinds, the coarse and the compact.

Primitive.

It was long conceived that gy of
the most recent formation, till a of
kind, undoubtedly primitive,
Saussure in the Alps. Dol
presses his wonder, that
more frequently formed fro
as the sulphuric acid might ly
from the decomposition of pyri
marks of Saussure must not be

"In regard to gypsum, it is f
Gothard, either below Ayrol, as I
§ 1805, or in the Val-Canaria. It
a fine and brilliant grain; it d
with acids, and consequently is
calcareous mixture.

"But what is more rare, is to
in a schistose form, and mixed w
of mica: this contains some
it slightly effervesces.

"I do not think that this gy
a primitive rock, like the
schistus; I believe it to be of
and that it originated by deposition

since the formation of the secondary mountains. The specimens which I possess are of a nature to justify this idea; their texture is not homogenous; the mica does not appear to have been united to the gypsum by a simultaneous crystallisation: it is in plates nearly incoherent, which separate thin layers of an argillaceous sediment. This mica then seems to have been brought down and deposited by the waters, rather than crystallised in them. Nevertheless, as I have not observed it in its native site, I dare not be too decided in this opinion."*

This gypsum was observed by Saussure in passing from Bellinzona to St. Gothard; but we are told by Brochant and Jameson that the primitive gypsum was discovered near Bellinzona; and they add, that it is in layers between beds of mica slate; and Jameson says, along with limestone and hornblende slate. I know not their authority for this assertion; but the objections of Saussure seemed to Patrin so powerful, that he virtually denies the existence of primitive gypsum, by asserting that it is wholly tertiary. The mixture indeed of mica is of little consequence, as it is found in the most recent sandstones; and even that of felspar, as observed by

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[*] § 1931.

Pallas in Siberia, would not now be regarded as of much importance. The pretended porphyries of Werner should, as already mentioned, be simply referred to their bases; for felspar, like mica, being found in every description of rock, can no longer be understood to alter the denomination.

This gypsum, supposed primitive,
tose structure, and approaches to
purity. A pure selenite, dividi
gles, was discovered by Gill I
left bank of the Doron, abo
Blanc; and in the same g
alabaster, and a red gyps . T
snow-white alabaster easily splits
is of a peculiar texture; it
acicular crystals of selenite, th
which this excellent mineralogist
ferriferous carbonate of lime*;
express his idea that it was of pr
tion.

Geognostic relations.

But these are minute exceptions;
neral gypsum and alabaster m
among the Floetz, the planiform,
rocks of Werner. Sulphate of lime

---

* *Chaux carbonatée jaune, ferrifère*, as marked in
which he gave me of several rock specimens. The
* Salins, near Moutiers, Mont Blanc.

a simple rock, like limestone, and sometimes occurs in large masses and beds; but sometimes in layers, alternating with orsten, clay, or sandstone. It sometimes contains crystals of quartz, and in rare instances arragonite and boracite. It also sometimes presents native sulphur; and often appears in the neighbourhood of rock salt. It seldom attains a great height, but forms little precipices, which, when of the purer kind, are distinguished by their white lustre. Hollows, like funnels, are sometimes formed in gypsum, which Saussure, 1238, ascribes to the rain water, which, attacking a soft part, remains, and, gradually increasing, melts the surrounding circle.

Gypsum is generally of a whitish yellow, or yellowish brown cast; but it also occurs of an ash grey colour, in which case, as Saussure has observed, it can only be distinguished from limestone by the nitrous acid producing no effect.

Montmartre.

One of the most remarkable gypsous hills in Europe is that of Montmartre, near Paris, not only from its producing the plaster best known in commerce, but from its peculiar constructure, and the singular animal remains which have there been discovered. It is thus described by the venerable M. Sage, whose chemical mistakes may be forgiven, in the consideration of the great services he has rendered to mineralogy, particularly by the formation of a noble cabinet, now the public property. The respect due to his excellent heart, and polite manners, is increased by the regret for his misfortunes, during a revolution which at length destroyed itself, by ruining even the natural and eternal aristocracy of talents; so that the members having, as it were, extinguished the eyes, were of course reduced to darkness and perdition.

Sage's description. "The hill of Montmartre is elevated about forty fathoms above the level of the Seine. The summit is covered with vegetable earth, under which is a bed of sand, mixed with rolled flints. This is seated on layers of marl, of different colours and thickness: this marl precedes and accompanies horizontal beds of gypsum.

"The quarries of Montmartre may be considered as divided into three successive large beds, or masses.

"The first, called *haute-masse* by the workmen, is often more than fifty feet thick; it presents beds placed one on the other, without any sensible interruption, although separated: they are seated on a bed of bluish argil, spotted, about twelve feet thick. This argil is intermixed with marl.

"The second part is called *pierre franche*. This gypsous mass, which is nearly fourteen feet thick, is disposed in contiguous layers, reposing on marl.

"The third part, called *basse-carrière*, presents a gypsous mass of about fourteen feet, divided into six beds, separated from one another by layers of marl. This last part is in the plain, and is incumbent on limestone.

"I shall not undertake to account for the formation of the gypsous hill of Montmartre, as well as those which are contiguous, and form a chain of eight or ten leagues, in a northern direction. Among the naturalists who have written on the quarries of Montmartre, M. Pralon, and the Chevalier de Lamanon, have, among others, given excellent lithological descriptions of this place. The latter affirms, that in this part of the Isle of France there was a lake of gypsous water, which gave birth to these quarries.

"The gypsous hills of Montmartre, Belleville, Pantin, and all those of this part of the Isle of France, are incumbent on quarries of limestone; the gypsous mass only extending to the evel of the soil. The shelly and argillaceous rock which is found on the summit of the hill of Montmartre contains white shells, brittle, of the class of chamites, and screw-shells: these shells are analogous to those which are found in the

river Marne, and in the rivulet of the Gobelins,
as is observed by Lamanon.

“ Infiltrations of black n t [*]
form very elegant dendrites,
mixed with argil. The dissolu
stone, infiltrating between the
sous masses, forms stalagmit
dulating layers, often distinct by t
brown, yellow, and white. Th
in beauty with the best of this ;
they have only been found in t :
several feet in length. The lir
filtrates into the gypsous n is
that they almost all efferv
cept the plaster-stone with a c
crystals of selenite, and those
name of *grignards*, a term besto
when it forms regular layers.
masses are broken with the han ,
a strong odour of decomposed *li*

“ The marl forms beds and
less considerable, in the plaster-c y
martre: argil is also found in it
quantity, and in different s :
cious and ductile; the other ex
and sticks closely to the tong

---

[*] Rather manganese.

" Heavy spar* is found in the marl at Montmartre: it is more abundant in the hill of Belleville, where it is met with in misshapen masses, greyish, flattened and rounded, at ten or twelve feet from the surface of the earth.

" The trunk of a tree agatised, which I found at Montmartre in 1778, serves to support my theory on the agatisation of vegetable substances. See page 168, vol. ii. of my *Chemical analysis of the three kingdoms.* This agatised trunk of a tree was thirty feet long, and nine inches in diameter; it was rather compressed, lying horizontally from north to south, and was at least 100 feet from the summit of the hill, between the two lowest beds of gypsum, of which the interior part was crystallised. The interstices of this agatised wood are ornamented with little regular rock crystals, of various colours. A part of this wood is brown and compact: this colour is owing to iron and oil, principles of the woody substance. I have inquired, since then, if any agatised wood had been found at Montmartre, and I was assured that it had not.

" The shelly sandstone which is found at Montmartre, seems of the same date with the agatised wood: this sandstone contains white calcareous muscles and clams. For the most part, it only presents the impre of th shells. In regard to the sand a , are found in the upper layers of Montmartre, they have no pecu and do not appear to differ from the sides of rivers; but in the n is found whitish silex, striped, this quarry, like the masses of shelly sa

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* Strontian.

"In the hill of Belleville, two feet f are found black flints, in beds f lar heaps; they lie in a kind , reposes on a bed of gypsum of ten feet, the layers, which are of different being intermixed with marl: this layer g sum lies on a considerable bed of gr under which the gypsum is again found*.

Bones.

"The bones which are discovered gypsum, have undergone no other than that effected by time: the gr have a yellowish tinge. M. de J served, that these bones are alw s with a kind of marl, which he r produced by the decomposition of t of animals. In the cabinet of there are icthyolites; the impression of the fish being compressed, as in schistus: nor are the fish solid, as in limestone.

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* This green clay corresponds with that of river which is green. It contains iron. See Vauquelin's s.

"M. d'Arcet possesses an ornitholite, or petrified bird, which he found, in 1781, twenty fathoms below the summit of Montmartre *.

"It has not yet been decided to what species of animals the bones found in gypsum belong. If these bones are neither agatised, nor penetrated with gypsum, it is because the absorbent earth, which forms their base, is found to be combined with phosphoric acid, and a fat substance †; consequently the selenitic water has not been able to decompose these bones.

"The brown hepaltic iron ore, solid, in an irregular mass, which is found dispersed in some places in the hill of Montmartre, seems to be the product of decomposed pyrites.

"The calcareous and gypsous *ludi,* in a spheroidal mass, flattened, called by the workmen *miches de quatorze sous,* are found to the east of Montmartre, near Clignancourt, in a bed of marl, from twelve to fifteen feet below the summit of the hill. Among the *ludi* of this kind, which are in the cabinet of the royal School of Mines, there is a spheroidal mass, flat, of two feet diameter, and seven inches thick; all the exterior crust is calcareous, granular, greyish, and a little argillaceous: it is an inch and a half thick. The interior of this *ludus* is filled with gypsous prisms, greyish, pentagonal and hexagonal, with interstices between them. These prisms are two or three inches in height, and one in diameter; their surface is strewed with small brilliant crystals.

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* It seems to be a water-rail.

† The *acidum pingue* is a favourite teet of M. Sage.

"The farinaceous gypsum, or white gypsous earth, is sometimes found in the form of *guhr*, but the crystalline gypsum forms considerable beds: they are often intermixed with *grignards*, or crystals of selenite, forming continued layers. Lenticular selenite is found in the marl: these crystals, grouped in different ways, have been precipitated from the aqueous fluid which held them in solution; the marl, which has afterwards settled, has encrusted, surrounded, and protected them. They are found in great quantities at the foot of Montmartre, towards Monceaux.

"Basaltic selenite, or in hex
with trihedral summits, alternate, with a
surface, is found in the marl, near t
of the hill of Belleville.

"Prismatic decahedral selenite, produced by the elongated octahedron, truncated near its

asis, is very scarce at Montmartre; but is
ommon in the hill of St. Germain-en-Laye,
here it is found in grouped crystals, spread in
red veined clay, which precedes the beds of
imestone, found towards the summit of the hill.

“ At Montmartre I also found striped sele-
ite, in small layers of two or three lines in
hickness.” *

One of the most singular discoveries made at
ontmartre was a horse-shoe, partly corroded
y age; but more than the half remains with
he holes very distinct. It is said to have been
ound at a great depth in the solid mass, and
ad most probably dropped into a reft, after-
ards filled by stalactitic matter, a common ap-
earance in gypsous regions.

Fossile bones did not attract so much curi-
sity when they were carelessly examined, and
upposed to belong to known animals. But the
ingular discovery in South America of the en-
ire skeleton of an animal larger than the ele-
hant, and of quite a different genus, and now
otally extinct †, led to more minute investi-
ations and comparisons, till it was at length

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* Sage, Supplement à la Description Methodique du Cabinet
e l'Ecole Royale des Mines. Paris 1787, 8vo. p. 124.

† See the print, Faujas, *Essai de geologie,* from the large plates
ngraved by order of the King of Spain.

discovered by microscopic eyes, that even the insects found in amber are not of the European kinds, but belong to distant regions. In the comparative anatomy of fossile bones, the celebrated Cuvier greatly distinguished himself, and by patience and research has nearly completed three skeletons of those found at Montmartre. For they belong to three kinds of animals, of the same genus, but of very different stature; one only attaining the size of a hare, the second of a hog, while the third reaches the size of the horse. Those animals approached the nature of the rhinoceros, the hog, and the American tapir, but were more nearly allied to the latter. Being herbivorous, as appears from the teeth, easily distinguishable from those of carnivorous animals, their bones seem to have been rolled down by the river to the spot where they are now found.

Shells. It might be imagined, that there is a kind of artful malice, if the expression may be pardoned, in the bosom of the goddess Nature, which allows human theory to sport for some time, and then brings out her stores for its destruction. It was long conceived, that fossile shells were confined to limestone, and fossile bones to gypsum, till very lately most of the sea-shells, found in the highest state of preservation in a bed of and at Grignon, about four leagues beyond Versailles, have also been discovered in the gypsum of Montmartre. Most of the shells found at Grignon, some of which retain their most delicate spines, and even their colours, are known now to belong to the South Sea, a portion of the Grand Ocean falsely called the Pacific; and but few to the Atlantic, or even the Mediterranean.

The various beautiful kinds of selenite, or crystallised gypsum, found at Montmartre, belong to lithology. The curious kind called vegetable selenite, from its resemblance to vegetation, seems confined to Derbyshire.

Aspect 1. Common gypsum, from Montmartre.

The same, with selenite, often elegantly interspersed with farinaceous gypsum.

The same, with blue variegated clay.

The same, in small layers of marl, &c. forming, as it were, a Montmartre in miniature.

The same, with imbedded ossilites, or bones of quadrupeds and birds.

The same, with various sea-shells; a recent and curious discovery. Brongniart says that some of the marl beds contain cardites, venerites or dionites, tellenites, cerites or screws (turbinites), and even bones of fish, and trunks of the palm-tree. Small pieces of iron-stone also appear, particularly on that side where the gypsum once bore a prismatic form, now destroyed by the progress of the quarriers, and which probably arose from the influence of that metal.

Aspect 2. Grey gypsum, from Mount Cenis.
The same, from Germany.

MODE X. ALABASTER.

Characters. Texture, compact, generally
grained; sometimes fibrous, even in
Hardness, gypsic. Fracture, ev
scaly. Fragments, amorphous,
Weight, carbonose, sometim
Lustre, glimmering. Sometir
even in pretty thick pieces; often
edges.

The colour is generally of the
sometimes slightly veined with grey:
stalactitic, it may be veined with y
brown, by ferruginous infiltrations.
veins it may assume a rose colour,
Passage, near Bristol, where it is

soft to be polished. It may also, like that near Nottingham, appear blue when held between the eye and the light.

It is now proper to pass to the consideration of that fine compact gypsum called alabaster. This substance, like alabastrite, is regarded as being a *sinter*, or deposition; but from gypsous rocks. Hence it is commonly found in small layers, and being rather soft, is used for little statues and ornaments. Yet Gmelin, who has ranked it under gypsum, assures us that it forms entire mountains, or at least very large strata, in Thuringia and Siberia*; but he probably confounds it with alabastrite, the ancient or calcareous alabaster. If, as Mr. Kirwan asserts, even mountains of gypsum are found†, alabaster may fill prodigious caverns. While Werner and his disciples are perhaps too minute in lithology and metallogy, they are in petralogy far too theoretic and general: but if gypsum be found, as they assert, in rocks distinguishable by their white colour, they must belong to alabaster. In fact, what has been styled primitive gypsum, particularly the cubic of Salins, Mont Blanc, is the purest alabaster; and naturalists ought to attend to common distinctions, and the purposes

Sites.

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* Linn. 118.

† Geological Essays, 238.

of art and utility, else the sapphire and the ruby might be confounded with corindon. It may seem particularly doubtful whether the kind called *anydrous* by the French mineralogists, because it contains no water of crystallisation, can properly be regarded as a *sinter*, or deposition from other beds; particularly that of Vulpino, which contains silex, and has been quarried for many ages. If gypsous alabaster form beds, which alternate with orsten and limestone, it cannot be regarded as the mere production of other rocks.

Mr. Jameson, who deserves to
with respect, upon account of his
vices to mineralogy, in treating c
sum, observes, that "it occu s
ash grey, passing into smoke grey, y
ish grey;" and closes thus, "It is d
architecture and sculpture, under
baster." Nothing surely can be
dictory to the common sense of n
Mr. Werner's new and elegant
White-stone, thus introduced to
a German Professor, "Whi
grey." The ingenious and intelligent
though a mere youth, gives a more
count.

Brard's account.

"Gypsous alabaster does not effervesce

nitrous acid; it loses its transparency, its lustre, and solidity, when exposed to fire; that is to say, that it changes into plaster.

"It is so soft as to be marked with the nail, and yet it takes a pretty fine polish; but it is true that the least friction will destroy it.

"It is never decked with lively colours; milk-white is its colour by excellence.

"Its transparency is sensible, even through thick plates.

"In short, its fracture or internal aspect varies much; sometimes it presents a crystalline and bright tissue, sometimes only a laminar contexture, or at other times only a dull and compact surface.

"As gypsous alabaster is much oftener white than calcareous alabaster, it is to that kind that the old proverb should be applied of *white as alabaster*."*

Monuments.

He informs us that the statues of the superb mausoleum of the Constable Lesdiguieres, in the cathedral of Gap, are of gypsous alabaster, from Boscadon, near Embrun, in the department of the Upper Alps. It is probable that those in the English cathedrals, generally executed by foreign artists, are of Italian alabaster. The alabaster of the department of Mont Blanc, of the most beautiful white, sometimes veined with grey, and receiving an exquisite polish, is much employed at Grenoble, the Gratianopolis of antiquity, and the chosen seat of Venus and Apollo.

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* P. 468.

Anydrous. The alabaster called *anydrous* is of several colours, white, rose, grey, and even blue, which is called celestine, a name now strictly belonging to a kind of strontian. The white anydrous kind is also found at Vizil, near Grenoble; and was used by the Romans, as appears from the beautiful mile-stone, or rather column, at Thin, on the banks of the Rhone, which is six feet high, and erected in the time of Aurelian[*].

Anydrous alabaster, mixed with a considerable quantity of silex, forms the *bardiglio* of the Italians, found near Vulpino, fifteen leagues from Milan, and employed in making columns, tables, and vases. It properly belongs to the Diamictonic Domain, where it is more particularly described.

White alabaster, from Derbyshire.

With a blue transparency, from Nottingham.

White alabaster, from the lower Pyrenees.

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[*] Ib. 473.

Yellowish white alabaster, from Lagny, about twenty miles from Paris, where it is used for columns and vases. It is translucent, and full of little cracks, which however do not affect its solidity.

Bright grey alabaster, with green and yellowish spots, from the river Niso, in Sicily; which affords many curious marbles, and other substances.

Gypsous alabaster, waved with red and deep yellow; from Taormina, in Sicily; another remarkable spot for a variety of marbles and serpentines, some of which were known to the ancients.

Translucent alabaster, of a bright yellow waved with white; from the isle of Gozzo, near Malta.

Travellers seldom observe whether a substance e found in such abundance, as to be useful to he arts. Hence even celebrated cabinets are, n the present confusion of the science, filled vith specimens from little fragments, or boullers, and vein-stones, which merely please the ye, and lead to no solid purpose of utility or cience. A final and perpetual division into lihology and petralogy, would obviate this among nany other inconveniences.

Anydrous alabaster, from Grenoble.

MODE XI. CHALK.

Characters. Texture earthy, rather fine, on a large scale generally stratified, with interposed layers of detached flints at regular intervals. The flint is sometimes schistose and continuous, as in the neighbourhood of Margate, and the North Foreland.

Hardness, of course, cretic. Fracture, even, earthy. Fragments amorphous, blunt.

Weight, pumicose.

Lustre, dull. Opake.

The colour is a dull white, proverbially k
but, wanting the brightness of
never been used to celebrate t c
beauty. From the decomposition of
of iron pyrites, which it often c ,
in parts assume a yellowish or grey

Sites. Chalk not only forms rocky cl
regular, bright, and imposing ct;
be said to constitute whole r A
portion of the south of England,
of France, consists of chalk; which, I
shire and Kent, is often covered wi
and in Champagne affords a light vi y
vine. It also appears in the flat

mark; while, in other countries, it must rather be regarded as a rare production. This extent of chalk in a N. E. direction, and its absence in the other parts of the world, is a most grand and singular geological fact, which does not seem to have invited deserved attention.

Mr. Jameson's account is so concise and exact, that its insertion will please the reader.

Jameson's account.

" 1. This appears to be one of the newest of the floetz formations, and is nearly the last link of the great limestone series.

" 2. It is very simple; for it contains, besides chalk, only a small portion of flint. The flint occurs in tuberous shaped masses, or in the form of petrifactions imbedded in the chalk; and sometimes it forms thin beds, which are more or less continuous, and alternate with thicker beds of chalk. It contains but few petrifactions, and these are principally echinites, ostracites, and belemnites.

" 3. It is more or less distinctly stratified. Like all new formations, it contains but few metalliferous fossils. All that have been hitherto found, are iron pyrites in small balls, and small portions of iron ochre.

" 4. Very few observations have been hitherto made, with the view of ascertaining its relative antiquity. Its occurrence on the sea-coast, and its earthy aspect, point out the lateness of its formation.

"5. It occurs only in low situations, and most frequently on sea-coasts, where it forms considerable cliffs; but when it occurs in inland situations, it rises into hills of considerable height.

"6. In England, it extends through Wiltshire, Hampshire, Surry, Middlesex, Essex, and Kent; and appears on the opposite coast of France, and stretches through the Netherlands. In the Baltic, it occurs in the islands of Zealand, Moen, Rugen, Wollin, and Saltholm; and it extends from Saltholm to the Swedish province Schönen. According to Dr. Steffens, the chalk at Stevens-klint in Zealand, and that of Moen, rests upon an aggregate of nautilites, serpulites, chamites, and corallites."

Shells. To the petrifactions may be added vast decomposed ammonites, as at Margate, pectenites, large pinnites, as at Meudon, near Paris, the glossolites or glossopetræ, called petrified palates, often of a bright brown and great beauty*; with what are called Judaic stones, seemingly spines of a large sea-urchin, dionites, &c. It has been remarked that the petrifactions in chalk seem more ancient than those in many limestones; and Brongniart has observed that they are chiefly pelasgian. The shells are often changed into flint, particularly the echinites. Sometimes unaccountably the shell retains its original appearance, and even lustre when broken; while the interior is a mass of solid flint, which has also been found to pass through the shell without affecting its texture, which could not have happened if the flint had been in a state of fusion from heat.

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* See Woodward and P. Tr. No. 232.

Patrin informs us, from Buffon, that a chalk region is also found in Poland; but he adds particularly in the territory of Sadki, where it is only found above an iron mine, with beds of other substances. This may perhaps be a soft white limestone, like that sometimes used at Lyons, and which has also been employed in building the famous bridge of St. Esprit over the Rhone. Some regard this last as a highly indurated chalk, which may be cut with a common saw, and becomes, like most other stones, more solid by exposure to the air, losing what the quarriers call the *rock water*. Indurated.

There is, on the other hand, a kind of chalk, which may be regarded as crude and imperfect, often consisting merely of comminuted shells;

and such are the falunes of Touraine, and other parts of France.

Uses. Its use, as a manure, seems to have been long known; and the numerous chalk-pits in England, sometimes of vast extent, have been dug for this and other purposes. When cleared by water from foreign particles, it is allowed again to condense, and sold under the name of whitening. Spanish white is merely refined in this manner; and the name is arbitrary, as it is manufactured in the north of France. Spanish white
not having the poisonous qualities of te-
there is room to regret that it is not br
more general use. Such are, it is l,
chief consumptions of chalk; the u
is rather condemned at the aleho ;
also sold at the shops for many
poses. In Woodward's time, t l i
Chalk eggs. generally carried chalk eggs fr ,
echinites, supposed to contain t
They were used to correct sick
and other disorders of the st h,
salted or gross food; and the a
would be approved by the mode
especially if chalk contain 11 of
asserted by Bouillon Lagrange; but ot
mists have only found about 60 of l

of carbonic acid*. The chalk-stones which appear at the joints of gouty persons, and greatly resemble that substance, are now said only to consist of uric acid and soda.

The structures and aspects of chalk, are rather various in minute parts, than in general masses; so that an excess of precision in this respect might, as sometimes happens, only introduce erroneous ideas.

Chalk, with various shells; from many parts of England, France, and Denmark.

The same, with the shells in flint.

The same, with balls of pyrites divergingly radiated.

MODE XII. TUFA.

Description. The name of calcareous tufa, is most justly applied to a light and porous rock, gradually formed and daily increasing by the depositions of springs and streams much impregnated with stony matter. It is, of course, the newest of all the mineral productions; and often contains

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* Da Costa, p. 77, says that chalk, called *creta*, from Crete, where it is found, as it is, among other places, in the archbishopric of Cologne, is used for the heartburn and diarrhœa. It is also employed in manures, to cleanse metals, and in baking sugars.

moss, grass, and other vegetables. The formation in many instances is so rapid, that it is ap-
Very modern. plied to the purposes of art. Nests of birds, and other small objects, are subjected to the stream; and, when covered by the deposition, are said to be petrified; an erroneous idea, for they are merely clothed with tufa. Such is the tufa common on the banks of the Tees, and other rivers in the north of England. By its lightness it is well calculated for vaults and roofs in buildings, where the use of wood would be dangerous; and, by its open intervals, admits the mortar, so as to form as it were one coherent mass; and it was used by the ancients in many constructions. The Pharos, at Dover, is chiefly built of tufa, from the north of England[*].

But as the Italians first used the word *tufa*, and seem more generally to have applied it to volcanic accretions, there is no impropriety in extending it, as is often done, to many loose and porous stones, evidently of recent forma-
Conchitic. tion. Thus the shelly tufa of Gmelin, consisting of broken fragments of shells, with sand and gravel, loosely joined by a calcareous cement, might perhaps be more properly classed here

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[*] This tufa seeming to join substances together, was exhibited by the surgeons in the fracture of bones, and called *osteocolla*.

han among the glutenites. Of this stone the elebrated temple of Jupiter Olympius at Agrientum, or Girgenti, in the south of Sicily, was onstructed, as appears from the ruins. The oarse limestone of Saillancourt, used in building the beautiful bridge at Neuilly near Paris, lso approaches to this kind.

The *Travertino*, with which the church of St. eter, at Rome, is constructed, is also a tufa, aily formed in the waters of the Anio, now alled the Tiverone.

Of aqueducts.

A fine calcareous tufa is also formed in anient aqueducts, in like manner as we see it very day in our tea-kettles. The ingenious Brard says, " Being in Languedoc, towards the iddle of June, 1807, I visited the great Roman queduct, known by the name of Pont du Gard: ascended into the gallery which terminates this old monument, and in which, anciently, the water ran which was conducted from Uzés to Nismes: I observed that the sides and bottom of this canal are encrusted with coarse tufa, 18 inches thick. In like manner also, and what has happened under the eyes of the Parisians, when in new modelling the garden of the senate, there was found, in digging the soil, canals; which are said to be as ancient as the time of Queen Blanche, and which brought the water from Arcueil to Paris; and these canals were entirely filled with the same sediment which that water deposes, even now, on the surface of all bodies on which it remains a certain time."*

Some establish a distinction between tufa and sinter; that the former is deposited in the open day, while the latter is formed under ground. But this seems arbitrary; and depositions of the purest alabaster, or alabastrite, may be equally formed in the open air, as at the Baths
St. Felippe. Philip, in Tuscany, where they appear equal
the most beautiful marbles, being received
moulds with the heads of Roman E
other objects. This ingenious n
established by Mons. Vegni. I t
belong to lithology; and the ne of
ever imply a coarse stone used in cl

Travertino. Of this kind, by far the most cele
travertino, already mentioned;
employed, both in ancient and m
the construction of the most n
fices of the most magnificent city in t
Hence a more particular account

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* Brard, 466.

† For example, the Coliseo or Flavian amphitl
i. 138, says the Travertino is of a sweet y
hardens by time.

interesting, and shall be given in the words of a skilful observer.

"The Anio or Tiverone, which descends from the Apennines of Vicovaro and Subiaco, to the east of Rome, before reaching the plain where it unites with the Tiber, crosses Tivoli; a place equally known to the learned and the artist, by its ancient monuments and its beautiful views, which have employed the pencils of the greatest masters. All the land through which the Anio passes in Tivoli, whether near the great cascade or the smaller ones, is filled with masses of a calcareous stone, produced by the deposition of its waters. Sometimes a piece of rush or reed, or other vegetable matter, is the first point to which the calcareous earth begins to attach itself. It generally deposes in concentric layers, and has the hardness and fibrous tissue of alabaster. These layers are nevertheless separated by a bed of calcareous earth, friable, yellowish, and very fine. At the foot of the mountain of Tivoli, where the Anio enters the plain, which extends to Rome, are the quarries of travertine. This calcareous rock is disposed in horizontal beds: its colour is yellowish white, its grain earthy, fracture uneven, and its hardness far surpasses that of those calcareous masses produced by the Anio, in the neighbourhood of Tivoli. Cavities, where the calcareous substance has assumed a sparry grain, and stalactitic forms, are common in travertine. Sometimes these cavities have been since filled by a calcareous stalactite, whiter, of a finer grain and harder. This is the origin of those white spots; the regularity of which, has caused them to be mistaken for marine bodies enveloped in its paste. Travertine contains no remains of marine substances; but sometimes it affords fragments of vegetables.

"It is not doubted but travertine owes its origin to the depositions of the Anio; depositions which, in the plain, may have formed a more solid and compact rock; because its current was less rapid, and perhaps its waters more stagnant in several places. Not far from the quarry of travertine is the Solfatara, so called on account of the great heat of its waters, which abound in sulphuric hydrogen gas, and form a considerable sediment of calcareous matter. A Cardinal d'Este caused the canal to be dug, which conveys the waters of the lake to the Anio. The calcareous depositions are there so abundant, that, if every three years it was not cleaned out, it would be closed up, notwithstanding its breadth and depth. The water which runs in the canal, on meeting with bits of rush or other bodies, covers them with a white calcareous crust, two or three lines in thickness. These incrustations are known by the name of Comfits of Tivoli*. Before this passage was opened, the overflowings, to which the lake is subject, were often so considerable that the water spread over the neighbouring grounds, and formed on their surface a stony crust. The water of the lake so charged with calcareous earth, uniting with those of the Anio, in the floods which their union must produce, have themselves contributed to the formation of travertine. I do not think that the Anio alone would have been capable of forming the quantity which is found of that rock.

"Independent of the immense quarries worked by the ancients, there are besides others of such vast extent, that they may supply the demands for many ages.

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* "Dr. Vegni had established there a manufacture of bas-reliefs, analogous to that which he possesses in Tuscany, near the Baths of St. Philip. The ingenious method by which he forces the water to form the bas-reliefs in a short time, which by the exactness of the design and the hardness of the stone, are not inferior to the originals, is sufficiently known by the relations of most modern travellers in Italy.

"I shall only add, that the colour, grain, and hardness of the stone formed by the waters of the Solfatara of Tivoli, as well as the neighbourhood of Rome, which furnishes so many beautiful models, and skilful artists, give this manufacture a decided advantage over that of Tuscany."

"The lake of Solfatara seems to have greatly assisted in the formation of this rock. Its water, charged with much gaz, explains by that quality the great number of hollows which travertine presents. It proves that when the rock hardened, a gaz has at the same time escaped in several places, which has prevented the approximation of its parts which were still soft. As often as the interior of a mass of rocks presents cavities, without any indication of foreign substances, which might have opposed the union of its parts, I conceive their origin may be attributed to the escape of gaz, at the moment when the substance was passing from a state of softness to solidity, by cooling or drying.

"From what I have just shown, it follows that travertine, or rock of Tibur or of Tivoli[*], is a carbonate of lime, formed by the depositions of the Anio and the Solfatara of Tivoli. The Roman artists give the name of travertine only to the stone taken from the quarry, situated at the foot of the mountain of Tivoli. The lithologists, less slaves to locality, bestow it on all calcareous rocks which possess the grain, tissue, and formation analogous to that of the travertine of Tivoli. If the ancient and modern

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[*] *Tiburtinum* of the ancients.

Romans have employed this stone in the most noble structures, they have but followed the examples of other people before them. The temples of Pestum, the most ancient monuments that are known after the pyramids of Egypt, were built with a travertine, formed by the deposition of waters which still exist in that district. This stone, when long exposed to the air, acquires a considerable degree of hardness; its colour assumes a reddish tinge, pleasing to the eye, and which in no small degree contributes to bestow on monuments of antiquity that majestic character which is so striking. Buch justly observes, 'that the temples of ancient, the churches and palaces of modern, Rome, would infinitely have lost of their grandeur and majesty, if the bold genius which erected them had not met with such a material as travertine. They would have lost much of their solidity, if the formation of tufa had not given rise to the discovery of puzzolana.' The chance which collects in its vicinity the materials most fit for architecture, travertine, and puzzolana, was not a little happy for Rome. The mortar or cement, which results from a mixture in just proportion of that ferruginous volcanic earth with lime, so much surpasses in hardness all other known cements, that the exportation of puzzolana, by the Tiber and the Port of Ostia, is become a little branch of trade."*

From the preceding observations, it might be understood that there are at least three different structures of the calcareous tufa: the porous, or that of the travertine; the shelly, like that of the ruins of the temple of Jupiter; and the tubular, like that of Germany, and the north of England.

STRUCTURE I. POROUS.

Travertine, from the ruins of Rome.

The same, from the quarries near Tivoli.

STRUCTURE II. CONCHITIC.

From the ruins of Agrigentum or Girgenti. It is found in many other places, but has excited little attention, being probably regarded as a coarse limestone; while its lax composition refers it to this mode, though Wallerius would perhaps have called it a tufaceous limestone.

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[*] Breislak, ii. 261. At Bionnay there are houses built of a calcareous tufa, containing fragments of lime-spar, limestone, and slate; the base being of a lively brick red colour, and strongly effervescent with acids. Sauss. § 752.

STRUCTURE III. TUBULAR.

From the tower, or ancient pharos, at Dover Castle.

The same, from the banks of the Tees, and other rivers in the north of England.

The same, encrustrating various objects, as birds' nests, plants, leaves, &c.

MODE XIII. CALCAREOUS INTRITE.

This mode is rare, and of little consequence, especially as the stones are not remarkable for beauty, and seldom used in the arts.

Porphyritic.

The most singular, is what Werner would call a limestone porphyry; being a compact limestone of a reddish white colour, sprinkled with minute crystals of white felspar. It was discovered by Gillet Laumont, in the mountain called Bonhomme, in the Alps.

Marble of Nonette,

Another calcareous intrite is a fine grained limestone, with angular spots of calcareous spar, something resembling a porphyry. It is of a yellowish white colour; and bears the name of marble of Nonette, from a place situate at the confluence of the rivers Alagnon and Allier, in the department of Puy-de-Dome. There is also a conchitic marble found near the same place; but the former being more easily worked, is preferred for chimney-pieces and other objects, according to the information given me by M. Lucas, a most obliging and intelligent youth, who has published some useful works on mineralogy. The father has the care of the collection of the *Jardin des plantes*; and by his respectable character, and gentle manners, prevented many outrages that were offered to that sacred deposit, during the times of anarchy.

MODE XIV. CALCAREOUS GLUTENITE.

This mode presents many important objects, as the celebrated bricias and kollanites in marble, with the calcareous sandstones, used for various purposes of construction. It falls, as usual, under two divisions, the large grained and the small.

STRUCTURE I. LARGE GRAINED.

Bricias of limestone are common at the bottom of many calcareous hills, but attract little attention; except in colour and grain, they belong to that noble mode called marble. A singular kind, described by Saussure, may suffice. He observed it at the Col de la Seigne, near the mountain of Bonhomme.

Singular bricia.

"On this road we find a quantity of fragments of a very singular calcareous bricia; and continuing to ascend, we leave on the right, above the path, the rocks from which these fragments are detached. The same bricias are again found in the same situation, on the opposite slope of the Col de la Seigne, and in the White Alley: but I shall describe them here, that I may not return to them. The paste of these bricias is sometimes white, sometimes grey; and the fragments which it contains, are some white, some grey, others brownish red, and almost always of a different colour from the paste which unites them. They are all of a calcareous nature, at least such were all those that I could see; and it is remarkable that they have all a lenticular form very much flattened, and that they are all placed in the direction of the plates of the rock: one would say, on seeing them, that they had all been compressed and bruised in the same direction. This same stone is mixed with mica, especially in the interstices of the layers, and between the fragments and the paste which unites them; but no mica is observed in the fragments themselves.

Infiltrations of quartz are also found in these bricias. This rock is cut by frequent fissures, perpendicular to the planes of the beds. It is palpably seen, that these clefts have been formed by the unequal subsidence of the beds, and not by a spontaneous retreat: for the pieces, or foreign fragments, are all divided, and distinctly cut by these fissures; while in the natural divisions of the beds, these same fragments are entire, and projecting from the surface. The nodules of quartz, and the several crystals which schisti contain, present the same phenomenon; and the same consequence may be drawn from it; they are divided in the clefts, and whole in the separations of the layers.

“ Although these flattened fragments, as I have said, afford, at first sight, the idea of compression, yet I cannot admit it; no other vestige of this compression being observable: I should rather imagine that these fragments have belonged to very thin layers, which have been rounded under the waters, by rolling and friction; that afterwards, when they have been successively carried down and lodged by the waters, they have taken the horizontal position that their weight imposed on them; and that afterwards the elements of the calcareous stone which forms the base of the bricia, and which was deposited at the same time, by alternately with them, have enclosed and kept them in that position."*

The *nagelfluh* of the Swiss is a bricia, with a calcareous cement; the fragments seem to be commonly siliceous; but Mr. Jameson says that a kind, wholly calcareous, is found in Bavaria; it is incapable of polish.

It is singular that no bricia can be clearly and positively assigned to the times of ancient art. Ferber informs us, that the Italians apply the word bricia to any marble, which has spots that are clear and distinct; while it ought to be confined to real bricias, consisting of fragments joined by a calcareous cement.

African bricia.

The bricia which seems to have the best claim to antiquity, is that called the African, which, on a black ground, presents large fragments of a whitish grey, of a deep red, or of a dull purple. Of this marble there is a large column in the Napoleon museum; but the name of African seems to have been bestowed merely on account of its black ground; for it is not mentioned by any ancient author, and, if known to antiquity, was probably Grecian; perhaps the Chian, with spots of many colours on a black ground. As the walls of their city were built with this marble, the tion might perhaps still be settled by a learn traveller. When they showed them in a b manner to Cicero, his dry sarcasm, their g pride and small domain, was, "I mired them more, if they had been b vertine." After all, this marble may pe be Italian; for Ferber informs us that the is still found at Seravezza, on the oppo of the mountain to Carrara, which is also *Africano*, and employed instead of t a The names, imposed by the ignorant ed dealers and artists, deserve no credit; intelligent traveller must study the undoubted remains of antiquity, those which continued in general es use for many centuries, as the Phrygian, the Numidian, and the Egyptian.

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* § 841.

No other bricia appears in Ferber
Antique. the ancient marbles of Rome; but some s are styled antique, probably only on their beauty. Such are the rose b a base of bright red, is enriched lit rose and black, with larger ones

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* Da Costa, p. 211, positively informs us that with red and white spots, is Italian, though called Afri

white; that called *arlequino*, which on a pale yellow, presents many fragments of various colours, resembling the beautiful bricia of Aix, but with more splendour; the chocolate brown, with little angular fragments of white; and the white with red fragments. What is called the grand antique, is composed of large fragments of black in a white cement*. The French apply the name, violet, to a bricia, which, on a ground of pale brown, presents fragments of lilac and of white. One of the violet bricias, described by Brard, is of a yellowish green; and presents white, green, violet, red, and orange spots: but our author does not seem carefully to distinguish between Italian bricias, which are often merely spotted, and the real bricias, which are composed of fragments.

Violet.

Among the bricias of modern Italy, may be mentioned what the French also call violet-bricia, being merely of a reddish brown, with white veins; that of Brentonico with large yellow, grey, and rose spots; that of Bergamo, of black and grey in a greenish cement; and that of Alcamo, in Sicily, of a bright grey with rose spots. The territories of Verona and Trent yield a beautiful bricia of pale red, crimson, and bluish fragments in a red cement. Spain boasts the bricia of Riela, in Ar-

Modern.

Italy.

Spain.

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* Brard, 340.

ragon, of a reddish yellow with fragments of black; and those of Valencia, of a pale yellow. That of Old Castile is much employed at Paris, being of a bright red, dotted with yellow and black, and enclosing fragments of a pale yellow, brick red, deep brown, and blackish grey*. They are rather round, so that it might be called a pudding-stone, if this division were natural; for in the original and beautiful pudding-stone of England, whose name has passed into all languages, the small pebbles are often angular, which, with many other instances, shows the division is unnecessary.

No bricia worth mention, seems hitherto to have been discovered in the British dominions.

France.

Brèche d'Aleppe.

France presents a beautiful marble of this description, very common at Paris. The ground is, in some pieces, of a pale brownish red, in others of a straw colour; and is itself chiefly composed of very small fragments of the same colours with the larger, which are of all shapes, and from half an inch to two or three inches in size. These spots are generally of a light brown, or straw colour, and are interspersed with other fragments of a slate blue and pale red, with others of a light grey and dull white: a striking singularity is, that the large brown spots have sometimes red edges, and an oval or triangular spot of light grey will have a red spot of the same shape in the centre; so that the very fragments would seem to be of original crystallisation, which has been modified, or rather disturbed, by some violent cause, at a particular period of its progress. This singular marble might, with the English kollanite, form a cabinet of study for the geologist; for the appearance of both is utterly irreconcileable with received opinions. As sand is now allowed to be often a product of original crystallisation, so pebbles, which are only a larger sand, must in the kollanite, and may in this calcareous rock, be of original formation, and afterwards agglutinated by a resumed progress of the process.

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* The celebrated *brocatello*, or cloth of gold of Catalonia, is by some regarded as a bricia.

This singular bricia is at Paris called *brèche d'Aleppe*, as if it came from Aleppo in Syria; but M. Brongniart informs us that this is a corruption, and that it should be called *d'Alet*, from a place about a league from Aix; yet he describes it as red, black, and grey, which must be quite a different sort. Brard, who has treated the French marbles with great care, says, that the bricia sometimes called of Aleppo, and sometimes of Alet, by the marble-cutters of Paris, is the antique violet bricia, which has been already mentioned;

but none of his descriptions in the least correspond with that under view*; and it is with regret that on this and many other occasions, the praise of accuracy, though it ought to form the chief ambition of such a work, must be withheld. *It* is also surprising that he did not learn, from Brongniart, that the bricia of Aix, which he compares with the *Arlequino*, must be the same with that of Alet in the vicinity of that town. His description of

Of Aix.

the bricia of Aix, in fact, corresponds with the present, as presenting grey, brown, and red spots, on a yellowish base. The same remark
tend to his bricia of Marseilles, which r
with white, grey, and brown fragments;
he adds, is much used and highly
Paris; where it is unaccountably l
Memphis. It is surprising that
has described Aix and its vicinity,
cated this singular marble, which
of his attention in every point of view.

Of Eygliers.

Another singular French mar
stone of Eygliers above Mont Dau
right bank of the river Guyl. Tl is c
of pebbles chiefly white, grey, and y
by a reddish cement, and receives t
Beautiful tables of this marble

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* P. 341.

Grenoble; and inspection must verify whether the pebbles have been rounded by friction, or the whole be an original rock of a particular crystallisation.

Others.

Another marble, called a violet bricia by the French, comes from Seix and other places in the department of Arriège, which is particularly rich in beautiful marbles. It is a coarse brown, spotted with lilac and white. That of St. Romaine, in the department of Cote d'Or, so styled from the excellent wines of Burgundy, is of a brick red with angular fragments of yellow. Doulers, in the department of the North, presents a bricia of many fragments, ash colour, white, and reddish. That styled of the Pyrenees, is of a brownish red, with black, grey, and red fragments, and has considerable reputation.

Of the common kind, Saussure has observed the following examples:

The mountain near Vevey is composed of coarse pudding-stone, the rounded flints being united by sand, and this sand by a calcareous gluten, which, in the rents and intervals of the beds, assumes the form of spar.

The pudding-stone of which Mount Rigi is composed, consists chiefly of red clay pebbles, so soft as to be affected by rain water, and united by a calcareous gluten.

A pudding-stone of fragments of black hornstein in a gluten of clay, iron, and lime*.

The chief specimens have been already indicated.

STRUCTURE II. SMALL GRAINED.

Calcareous sandstones are regarded as common.
That of Fontainebleau, which is commonly reckoned calcareous, does not, by Brongniart's account, always effervesce with the nitrous acid;
but only that of two quarries, Bellecr
mours, in which the curious crystals
The others afford siliceous

The sandstones which
colours, and dendritic delin
chiefly argillaceous, the clay cement
pregnated with iron. Calcareous
alternates with limestone, and is
Sites. to the same formation. It is the
all the sandstones, and forms long
from Osnabruck down to Hessia,
Rhine. It also constitutes the
ton of Berne, and rises into
tains in the south of France, par
Caume, on the north of Toulon,

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* § 1099, 1941, 1529.

of alternate beds of limestone and calcareous sandstone*.

Of Fontainebleau.

According to Patrin, the sandstone of Fontainebleau is always a calcareous glutenite; but when he praises its utility at Paris, where it is employed in paving the streets, he forgets that it wears out in three years; while granite might be had from Cherbourg, which would last thirty. This celebrated sandstone sometimes forms regular beds, and sometimes only appears in blocks, dispersed in heaps of pure quartzy sand, upon which the gluten does not seem to have acted. For Romè de Lisle has long since remarked, that such sand is often a pure homogenous production of nature, which must not be confounded with those proceeding from decomposition†. The formation of this stone seems illustrated by the noted crystals, which, though composed of quartzose sand, assume the rhomboidal form of calcareous spar; and some even present crystals of a beautiful yellow spar, quite transparent. Perhaps it was in a different quarry, that Lassone made the singular remark, that the new surface, at the end of some months, was covered with a glassy crust of a siliceous nature, arising from some lapideous juice, which remains, as before observed, among the secrets of nature; because stones have never been analysed in their original state.

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* Patrin, iii. 324. He seems singular in his opinion that the building stone used at Paris is a calcareous sandstone, while all others regard it as a konite. See Brongniart, art. *Moellon*, i. 204. It is the *chaux carbonatée grossiere* of Haüy.

† ii. 63.

Even Mr. Kirwan has little enlarged upon the calcareous sandstones. Mr. Jameson has, as usual, employed much labour in illustrating the different formations; but he has not drawn a precise line of distinction between the different kinds; as it is probable, however, that his third formation is chiefly a calcareous glùtenite, the following curious observations well deserve a place here.

In columns.

"No rock presents a greater variety of external appearance than this sandstone. Its valleys are deep, rocky, and romantic; its hills conical, steep, and cliffy; and it often presents grand colossal pillars and masses, which, from their number and variety of their shape, form most striking rocky scenes. These hills, pillars, and masses, often reach a considerable height; but their summits are all nearly on the same level. One of the most striking appearances of this kind is at Adersbach, in Bohemia. There we observe numberless cones, pyramids, and pillars, sometimes isolated, sometimes joined together, and from two to three hundred feet high, spreading over a considerable tract of country. In other places, caverns or

tos appear, from which there issue many
ams, that give rise to waterfalls, and thus in-
se the beauty of this striking scene. These
rns are wide at the mouth, but become very
ow towards their further extremity, and are
rally very short. This form shows that they
their existence to external agents, particularly
er. A more near examination discovers that
seams of the strata of the different isolated
ses correspond to each other; which renders
robable that all these cones, pyramids, and
rs, have been formerly united; and that the
endicular rents or fissures have given rise to
disunion, which has been afterwards increased
he action of the air, and by the water carrying
y the softer or more loosely aggregated parts
he sandstone, and leaving the harder parts in
e various forms. A similar appearance of
lstone occurs near Tunis, and, from its striking
mblance to ruins, is described as the remains
great city, by some travellers who saw it at a
ance. In the land of the Namaquas, in
hern Africa, and on the banks of the Wolga,
e are similar appearances."* This glutenite
, however, be argillaceous.

Geognosy, 161. Soulavie, tome i. gives a print of square cal-
us columns at Ruons, on the river Ardeche.

In his edition of Linnæus, Gmelin has produced various minute substances, while he ought to have begun this genus with his sixteenth species, as the most important, being the *Quadrum*, celebrated as he says in architecture*. The venerable Wallerius has with more judgement, as usual, described the *quadrum*; so called, as he says, because it often rises in square forms. He establishes its calcareous nature; and says that it is of great use in architecture. He mentions the white, the yellow, the grey, and the red, the latter being from Shropshire. Pott, Vogel, and others at first supposed this stone to be mainly calcareous, and even the sand may in fact be calcareous; but in general, upon leaving a small fragment in the nitrous acid, the quartzy sand will become visible or tangible. A useful observation is, that the nearer to the sea it is quarried the less it will withstand the weather, as any saline particles attract the humidity, which freezing frost expands and splits the stone. In like manner if konite be accidentally moistened with sea-water it will be subject to decay.

In the passage of Fours, near the mountain of

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* He ranks it among the calcareous, though by his description it must be argillaceous. The cement is, however, sometimes of [illegible] or a mixture of lime and clay.

Bonhomme, Saussure observed a remarkable sandstone, which he thus describes:

Of Fours.

"All the beds of sandstone observed on this mountain do not contain rolled pebbles; there being irregular alternations of beds of pure sandstone, and beds mixed with pebbles. The most elevated contain none. The highest of those which contain any, is a continued bed of a foot in thickness, and which rises 30 degrees to the N. W.

"Some of these beds, filled with pebbles, present a very remarkable singularity: on their external surface exposed to the air, is observed a kind of network formed of black and saliant veins, two or three inches above the surface of the rock; the meshes of this net are sometimes irregular; but for the most part they are oblique-angled quadrilaterals, whose sides are eight or ten inches long. As these rocks have all a tendency to split in rhomboids, it seems that there have been formerly clefts, which divided the beds in parts of this form; and that these clefts have been filled by sand, which has been cemented by a ferruginous juice: this solid gluten has made these parts harder than the rest of the rock; and when the injuries of the air have attacked the surface of these beds, the meshes of the net have remained protuberant.

"The rounded pebbles, which have been long exposed to the air, have also outwardly assumed a blackish ferruginous tint; but those which are still enclosed in the beds of sandstone have, like that, a yellowish colour. I found none in it which were not of a primitive nature; and the most part were of a very hard grey or reddish felspar, and confusedly crystallised. They are then stones which do not naturally possess a rounded form, and which consequently only receive that they have here, by rolling and the friction of the waters.

"All these sandstones effervesce with acids; but the ferruginous parts of the net much less than the base itself. In like manner, if the sandstones which contain pebbles, and those which do not, are compared, in the former will be found more calcareous gluten, their coherence being much more diminished by acids. On the very summit of the mountain these sandstones are covered by a grey shining slate, which exfoliates in the air; and descending from this same summit, on the N. E., on the opposite side to the passage of Fours, beds of sandstone will be observed exactly similar, and which there divide of themselves in small parallelopiped fragments."*

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* § 780.

Saussure also gives numerous other examples of alcareous sandstones.

Near Vaucluse, § 1545, are beds of sandstone, omposed of angular and round fragments of ansparent white quartz, and of yellowish or reenish steatite, semitransparent, in a calcareous luten.

Of Vaucluse.

A sandstone, § 1564, of a red wine colour, inlining to violet, very fine, and spangled with calareous spar. It makes a warm effervescence ith the nitrous acid, leaving a sand of white uartz, and some grains of felspar.

A sandstone, § 1487, composed of grains of uartz, and a kind of red ochre, in a calcareous ement.

The sandstone of Voisy, § 304, consists of uartzy sand, mingled with a little clay, and nall specks of mica, all united by a calcareous luten, which sometimes assumes the form of par in the interstices of the beds.

Recent formation.

" I have seen myself," says this accurate uthor, § 305, " on the shores of the Mediternean, near Messina, and the noted Gulph of harybdis, sands which are moveable, when the aves heap them on the shore; but which, by eans of a calcareous juice which the sea infilates at that spot, harden gradually, so as to serve for mill-stones. This fact is well known at Messina; and stones are incessantly taken from the shore, without their being exhausted or the spot being lowered. The waves throw fresh sand into the vacancies; and, in a few years, this sand becomes so agglutinated, that the stones of new formation cannot be distinguished from the ancient."

In § 583, Saussure mentions rocks consisting of alternate layers of limestone and calcareous sandstone, in the mountain of Buet. In the same mountain there is a pudding-stone, composed of fragments of grey and reddish quartz, reddish felspar, and little yellow pyrites, united by a calcareous cement.

The *molasse* of Geneva is a sandstone with a calcareous cement, and a mixture of clay. It is soft and impure. That of Lausanne is one of the hardest and [illegible]: it is of a beautiful grey inclining to blue, with a calcareous gluten. The mountain of Voirons, two leagues from Geneva, chiefly consists of calcareous sandstone*.

Calcareous sandstone, from Fontainebleau.

The same, from Livonia.

The same, from Gothland, Sweden.

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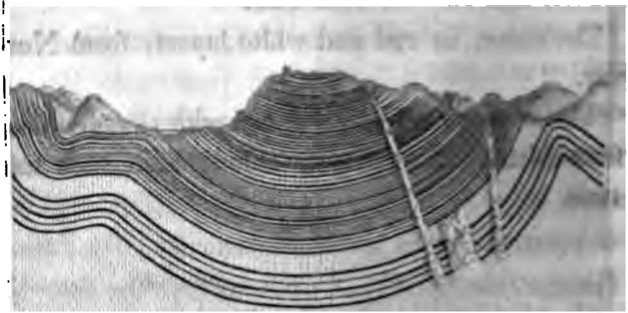
* Sauss. § 61, 1100, 273.

The same, from Swisserland.

The same, with limestone, from the south of France, and various countries.

The same, in red and white layers, from Norway.

The same, of a brownish red with silvery mica, from Metz. That city is chiefly built with this stone.



DOMAIN VI.

CARBONACEOUS.

◆

CARBON.

Name.

THE name Carbon is not the most happy, as it arises from charcoal, an artificial substance, while carbon is now well known to be an original element, which exists in the purest state in the diamond, and enters into the composition of siderite, perhaps

Carbonic acid.

he most ancient of all the rocks. Char-
oal is now regarded as a mixture of car-
on and hydrogen. By combustion it is
onverted into carbonic acid gas, formerly
alled fixed air, or aerial acid; whence
ome writers have used the epithet aerated
ime, barytes, &c. for what are now called
arbonates of lime, barytes, and the like.
he discovery of this new air by Dr. Black,
ed to wonderful improvements and a total
enovation of chemistry, which in its pre-
ent form has been called pneumatic, from
ts spiritual foundations. It is indeed re-
arkable, that the profoundest study, and
he most patient experiments, should con-
uct us from matter to spirit; and thence
y a natural gradation of thought, to that
effable spirit, the Creator of the uni-
erse.

The carbonic acid gas, more briefly call-
d carbonic acid, forms a constituent part
f the atmosphere, in the proportion of
bout 1, in the 100, while the remainder
onsists of about 77 of nitrogen and 22 of
xygen gas. Combined with the earths, it

forms carbonates: and that widely extended substance called limestone, which is often primeval, is a carbonate of lime.

Carbon itself not only appears in the purest state in the diamond; but forms the preponderant part, sometimes even 90 in 100 of the substances now under view, and which have therefore been called carbonaceous. They not only enter into the composition of rocks, and some even of the primitive, but form rocks themselves, as coal has been found in masses of 80 or 90 feet in thickness. The trivial name of sea-coal, arising from its importation at London, might therefore well be exchanged for that of rock-coal, as we say rock-salt. Some might, perhaps, prefer the German Bergarts. appellation of *bergarts*, implying substances of whatever kind which enter into the composition of mountains; or the Geostromes. Greek *geostromes*, proposed by I
denote the strata of the earth.]
conchitic beds of limestone, some
more recent than coal itself, t
in thin strata, universally assume t

appear unnecessary. It has already been more than once observed that the division of mineralogy into three quite distinct and separate provinces, METALLOGY, LITHOLOGY, and PETRALOGY, would be of the utmost importance to the progress, illustration, and utility of the science; each of them being amply sufficient for the life and labours of one man; and, in this case, the subjects under view could not be allotted to any other grand division.

MODE I. GRAPHITE.

Characters. Texture, fine grained, but sometimes coarse, schistose.

Hardness, cretic. Fracture scaly foliated, sometimes slaty and uneven, sometimes rather conchoidal. Fragments amorphous, rather sharp.

Weight, carbonose.

Lustre, metallic. Opake.

Colour, somewhat leaden, which occasioned the vulgar, but very improper, name of black lead.

When pure, it usually contains about 90 parts oxyd of carbon, with 10 of iron; but the foreign kinds are often contaminated with large mixtures of argil and silex, which renders them unfit for the usual purposes of writing and drawing.

Sites. The best is that found at Borrodale, in Cumberland; a mine which has long supplied the world with this valuable article; but the French have lately succeeded in the fabric of an artificial kind. Graphite has also been recently detected in the southern parts of Scotland, with a singular kind of coal, called columnar, because it appears like little basaltic prisms.

It is sometimes of a scaly appearance, which Werner has arranged as a subdivision.

In the perusal of books of mineralogy, every udicious reader must have remarked that, according to the various dispositions of the authors, hey are fertile and satisfactory on some topics, nd barren on others: whence the great utility f compilation, whose office, from the days of Aristotle and the first dawn of science, has been o collect, and arrange for the universal benefit, acts and observations, which became more valuable from being concentrated. The prince of he Roman poets compares this practice to that f the bee, who prepares her elegant edifice and seful honey from various flowers, some of which nly perfume the desert air. This work has, herefore, without hesitation or apology, adopted iteresting descriptions from former writers, whether domestic or foreign, but especially the atter; for many excellent works are published which will not bear complete translation, but of which detached portions are highly satisfactory nd interesting. Such is the elementary treatise n mineralogy by the ingenious Brongniart, director of the celebrated manufacture of porcelain t Sevres, whose accounts of graphite and anthracite (which will follow in its proper place), are the most ample and satisfactory which have yet appeared.

Brongniart's account.

"Graphite is of a grey almost black, with a metallic lustre; it is soft, smooth, and even unctuous to the feel; its fracture granular; it leaves distinct marks on paper, clear, and of a *bluish* black; it even leaves marks on vitreous surfaces, such as earthen-ware: its marks are grey, while those of sulphuretic molybdena, which much resembles it, are greenish.

"Its specific gravity is from 2,08 to 2,26. It consumes and volatilises under the blow-pipe, by a continued heat. Nitre renders its combustion quicker and more sensible.

"Slightly rubbed on resin, it does not communicate any electricity to it, while it leaves a kind of metallic coat.

"This substance, according to t
ments of Mess. Berthollet and
posed of iron and carbon, in t
0,90 of carbon and 0,09 of iron.
too small a quantity to rank
iron ores.

"1. *Laminar Graphite.* It is
mellæ, or rhomboidal, or he
is of a tin-white.

"2. *Granular Graphite.* It is in

masses, or compact lumps, with a granular fracture, the grains more or less fine.

"Graphite seems to belong exclusively to primitive regions: sometimes it enters into the composition of the rocks which form those regions; sometimes it is found in masses, or in considerable layers. It is likewise met with in beds of argillaceous schistus.

"It is found:—in France, in the department of Arriège, in large compact masses; in the department of Mont Blanc; in that of Sture, near Vinay, above the baths; in the mountain of Lubacco, and in that of Gogni d'Orgial, in small veins in granite. In the valley of Pellis, district of Pignerol, department of the Po, in veins of a yard in thickness, in granitic rock (Bonvoisin). In Spain, near Sahun, district of Benabarra, in the mountains of Arragon (Parraga), and near Casalla and Ronda in the kingdom of Grenada. In Bavaria: in Norway near Arindal; this is the laminar variety. In England, at Borrodale, two miles from Keswick in Cumberland, this is the most celebrated graphite mine; pencils of an excellent quality are made of it, and recommendable, as being at once firm and soft. The bed of graphite is in a rather high mountain, between layers of a slaty schistus, crossed with veins of quartz; the bed or vein which it contains, is nearly three yards thick; the graphite is there found in large masses, but of different degrees of quality; what is not good, is thrown away.

" Pencils, which are enclosed in cylinders of wood, are made of graphite. In France they are called *mine de plomb*, or capuchines. The pieces of graphite are sawn in very thin quadrangular sticks, which are put in a groove made in one of the halves of the wooden cylinder, which is to form the envelope of this fragile pencil.

" The dust of the graphite, mixed with gum, forms pencils of an inferior quality.

" This same dust serves to lay over iron, and especially cast iron, to keep them from rust; mixed with grease, it is used very efficaciously to diminish the frictions in wheel engines.

" Also, mixed with argil, at Passau in Germany, they make crucibles of it, which resist extremely well sudden transitions of temperature, and which are used by smelters.

" Laminar graphite is often formed artificially in the flaws of cast iron, and in the cavities of furnaces where iron is used. M. Fabroni affirms that it is also sometimes formed in the humid way; and cites, on this occasion, the pits dug in the territory of Naples: an acidulous water is collected in them, at the bottom of which, graphite is gathered every six months."*

Our ingenious author is mistaken, when he says the graphite of Cumberland is found between layers of a kind of slate, traversed by veins of quartz. Several specimens of the rock are now before me.

Graphite of Borrodale.

1. Nodules of graphite in the rock itself; which appears decomposed, and in some parts tinged with oxyd of iron, arising from the partial decomposition of the graphite. The stone easily yields to the knife, and is of a bluish grey colour mottled with white. It has an unctuous steatitic appearance, and seems to be a decayed serpentine.

2. The same rock, at a further distance from the mineral, and undecomposed. This seems a Saussurite, or magnesian basaltin. It is of a deep grey colour with dots of light brown, which may be a decomposed felspar; and is mixed with large patches, which approach the nature of indurated steatite, of a light greenish grey, mottled like the decomposed substance which contains the nodules. It is, upon the whole, a magnesian rock, of a particular description, with a stong argillaceous smell, in this and other

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* Brongn. ii. 53.

characters approaching to some serpentines; for that peculiar odour does not arise from the argil, as commonly supposed, but from the iron contained in the argil, and therefore expires from many rocks not argillaceous. It is worth observation, that serpentine has never been observed to contain any metal except iron, and its relatives pyrites and garnet; so that it is not surprising that it should contain graphite, or carburet of iron. Perhaps the superiority of the English kind may be owing to this circumstance, the unctuous nature of the rock imparting that quality to the mineral; as common flint becomes menilite, from the unctuous and magnesian marl in which it is deposited.

Another rock is found at Borrodale, I know not if in contact with the former, but it appears somewhat allied from the structure and nodules. This seems to be a magnesian felsite, of a dark grey colour, dotted with little reddish crystals, and with greenish nodules. It is well known that the British rocks are often anomalous, or transilient, and can scarcely be reduced to precise denominations, till the science shall have made a far greater progress than it has at present.

Of Chamouni. Saussure discovered graphite, which, with the writers of that time, he calls *plombagine*, on schistose quartz, among the Alpine fragments in the valley of Chamouni; but upon reaching the rocks, it only formed a kind of gneiss, being thin plates of graphite interposed between layers of quartz, thus assuming as it were the place of foliated mica.

STRUCTURE I. MASSIVE.

Aspect 1. Fine. From Borrodale, near Keswick, in Cumberland.

The same, in nodules in the rock already described.

The same, as found with columnar coal, from Scotland.

The same, from the north of Italy, France, &c.

Aspect 2. Coarse. This is commonly mixed with silex, argil, and other impurities.

From various parts of France and Germany.

STRUCTURE II. LAMINAR.

With laminar quartz, from the valley of Chamouni.

From Arindal, in Norway.

Laminar graphite, interposed at certain intervals in gneiss, from Greipon, in the Alps. Communicated by Gillet Laumont.

MODE II. ANTHRACITE.

Characters. Texture, schistose and incoherent.

Hardness, cretic. Fracture, slaty. Fragments, amorphous, rather sharp.

Weight, carbonose.

Lustre, sometimes dull, but generally glistening and even metallic. Opake.

The colour is often a dark black, but sometimes has a metallic reflection, which is particularly conspicuous in that elegant kind called Kilkenny coal; and which might with much Kirwanite. propriety be called Kirwanite, in honour of the great Irish mineralogist, who first introduced it to scientific attention. The French continue, most unaccountably, to confound it with canel coal, which is quite a different substance*.

Anthracite seems to have been first observed by Dolomieu; but Born, in his elegant catalogue of Miss Raab's collection of minerals, has classed it under graphite, which he calls *plombagine*, or carburet of iron, in the following terms. It must not at the same time be forgotten, that Pliny uses the word *anthracites*, in a very different sense, for a gem which has the effulgence of burning coal.

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* In order to obviate this error, the author, among many other British substances, placed specimens of Kilkenny coal in the museum of the *Jardin des Plantes*, and another great collection at Paris.

"Coaly Plombagine. Anthracolite.

Born's account.

"This kind of plombagine has recently been discovered at Schemniz, in Hungary, which differs from the known plombagine, as being very light, compact, brittle, of a shining and conchoidal fracture, and without soiling the fingers is easily broken. It has but very little iron in its mixture, and therefore when calcined under a muffle, slowly dissipates, and loses 90 parts of its weight. According to the analysis, lately made at Schemniz, in Hungary, in 100 parts there are 90 of carbon, 5 of argil, 3 of iron, and 2 of silex.

"It seems to have some affinity with the incombustible pit-coal, described by M. de Morveau in the new Memoirs of the Academy of Dijon. *Prem. Semest.* 1783, page 76—86.

"Mr. Struve has just given the description and analysis of a fossil, which, with the exception of the colour, still more agrees with this variety of plombagine. He calls it also coaly plombagine. See Journal de Physique, 1790, January, p. 55.

"Black compact coaly plombagine, with

a shining fracture; of Pacherstolln at Schemnitz, in Hungary.

"It adheres to a blue argil, greyish, mixed with pyrites. The vein, in which it is found, is filled with this argil, which is only a decomposition of the metalliferous rock. It is in this argil that different sized pieces of this coaly plombagine are found, which for the most part have a cylindrical form. They even seem to be composed of concentric layers round a kernel; in short, this plombagine nearly resembles wood, and to all appearance has a vegetable origin."

Of the Alps. Estner also agrees in the wood-like appearance of this anthracite. Among other rocks presented to me by Gillet Laumont, are different specimens of anthracite, which he says is also called *houille sèche*, or dry coal. There is particularly a specimen of that mentioned by Dolomieu, as belonging to primitive regions, and containing no traces of vegetables, from little St. Bernard, in going to the fort in the Alps. This is accompanied by the following specimen and note: "Vegetable impressions, which I first discovered in 1803, serving as a roof to the same anthracite, or dry coal, the wall or under-rock being also a schistus. I had one very fine, with little ramified plants, and another with reeds. A little impression is on this specimen; but the finest are in the cabinet of the Council of Mines." Another specimen of anthracite is from Allues, Mont Blanc; and a third, which is slaty, is from Regny, near St. Simphorien de Laie, on the road from Roanne to Lyons.

The best account of anthracite, as already mentioned, is that given by Brongniart, which shall therefore be translated.

Brongniart's account.

"Anthracite so much resembles coal, at first sight, that for a long time it was taken for a variety of that combustible mineral. Nevertheless, artisans who used it had remarked, that it burnt with great difficulty, and did not produce either that white flame, or black smoke, or that bituminous odour which arises from coal; therefore it was called, incombustible pit-coal.

"Anthracite is of a black less opake than coal; its colour approaches nearer by its brightness, to the metallic black; it is also more friable; it is rough to the touch, and easily stains the fingers; it leaves a black mark on paper, which, if examined with attention, seems of a dull black. These characters serve to distinguish it from graphite, which leaves a bright mark, and is unctuous to the feel.

"The texture of anthracite, sometimes schistose, sometimes compact, at others granular, is too various to serve as a characteristic. Its specific gravity, which is 1,8, is inferior to that of graphite, in the proportion of 9 to 14; and exceeds that of coal, as 9 to 7.

"This mineral is decidedly opake, it easily allows the electric spark to pass, is hard to burn, and in its combustion never produces but one substance, which is carbonic acid.

"The matter essential to its composition, is mixed carbon; or perhaps combined sometimes with silex and iron, sometimes with argil and silex in very different proportions, according to analysed specimens.

"1. *Friable Anthracite.* It is in mass, granular, not schistose, greatly soiling the fingers, and easily crumbles.

"2. *Scaly Anthracite.* It divides into large solid scales, the surface of which is unequal, undulated, and shining; it soils the fingers less than the preceding.

"These two varieties are found at the villages of Arrache and Macot, in the neighbourhood of Pesey, department of Mont Blanc.

"3. *Schistose Anthracite.* (*Haüy.*) It divides into laminæ, with an uneven and undulating surface.

"4. *Globular Anthracite.* (*Haüy.*) It found in small globular masses, in cr carbonate of lime, at Kongsberg in N

"Anthracite is often found in primitive regions, which is a remarkable circumstance in a combustible which seems so nearly allied to coal. It generally is found in mica-slate, and even gneiss; it is sometimes in beds, sometimes in veins. Its layers are often winding and contorted, like those of the rocks with which it alternates.

"Dolomieu saw anthracite in veins, in the porphyritic mountains near Chapelle, department of Saone and Loire. In the Tarentaise of Savoy, it contains 0,72 of carbon, 0,13 of silex, 0,03 of argil, 0,03 of iron, and 0,08 of water. Primitive anthracite is found in Piedmont, at the foot of little St. Bernard. In the department of Isère, in lumps or heaps, in the midst of a pudding-stone, composed of primitive rock, and without any vestige of organised bodies. At Musy, near Clayte, in the former Charolais. At St. Simphorien de Laie, in the environs of Roanne. At Diablerets, in Valais.

"M. Ramond has mentioned an interesting variety, which he found at the bottom of the valley of Heas, the upland of Troumose, department of Upper Pyrenees, in the midst of mica-slate. This anthracite disposed in veins, only contains carbon, mixed with a small quantity of silex and argil, there not being any iron. This circumstance fully distinguishes anthracite from graphite.

" M. Fleuriau de Bellevue has found anthracite crystallised in regular hexaedral plates, on a granitoid, which is found in isolated blocks on the quays of Saardam, in Holland*. *It is* thought these rocks have been brought from Norway. This anthracite, according to M. Vauquelin, only contains carbon, silex, and argil.

" Anthracite is also mentioned in the neighbourhood of Schemnitz, in Hungary, in a vein. At Kongsberg, in Norway, it is mingled with native silver. In Spain, in the port of Pajares, which separates the kingdom of Leon from the principality of the Asturias, it reposes on a clay-slate; and, according to M. Proust, contains 0,93 of carbon, and 0,07 of sand, argil, and iron. It is used in painting, the same as lamp-black. (D. B. Canga-Arguelles.)

" Anthracite is not exclusively found in primitive regions. M. Héricart-Thury has shown that that which is found in the department of

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* In the curious collection of rocks formed by the venerable Besson, formerly director-general of the mines of France, the author was surprised to find numerous specimens from Zealand; and the possessor has even adduced them as such in his printed work. They were from ballast thrown on the quays of Zealand. The quays of London furnish many curious rocks.

Isere, near Allemont, towards the summit of the mountain of Challanches, at an elevation of 2563 yards, is secondary. It lies between two beds of black schistus, covered with impressions of vegetables; it contains no bituminous matter, and has 0,97 of carbon, so that it is nearly pure carbon. That of Rousses, opposite the same mountain, and that of Venose, near the village of Oysans in the same valley, are also of secondary formation. The anthracite of Lischwitz, near Gera in Saxony, is in layers of clay-slate, covered with vegetable impressions. (Roemer.)

"The anthracite which contains no indication of vegetable coal, is wholly incombustible; that which contains any, may burn, if two-thirds of charcoal be added to it. (Héricart-Thury.)"*

Brochant observes, that if anthracite be held a long time on fire, moving it often, it consumes slowly without any flame; but only encircled with a little glory, or irradiation, like red iron and diamond. During this operation it loses about two-thirds of its weight, and the residue is of a blackish grey, which announces that the combustion is imperfect.

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* Brongn. ii. 55.

It is worthy of remark, that as anthracite has been found in a primitive glutenite or pudding-stone, so the usual gangart of diamonds, both in Hindostan and Brazil, is a ferruginous pudding-stone. The author has had the satisfaction of seeing one of the Deccan in the gangart, the pebbles being an unctuous quartz approaching to chalcedony, as in the singular sandstone of Egypt; but some seemed impregnated with iron, so as to bear some appearance of imperfect light brown jasper. A little fragment seemed to be siderous slate.

Anthracite is by Mr. Kirwan called native mineral carbon. He observes, that the kind found at Lischwitz, in extensive strata, and that of Strido in Tuscany, are among the most pure. Kilkenny coal. He rightly classes the Kilkenny coal as an Anthracite; and, by his analysis, it must be one of the purest, as it contains no less than 97 of carbon. But it seems of a different structure from the anthracite found on the continent, having a far more compact appearance, with a metallic lustre at once more bright and steady; nor is it so brittle, nor so ready to stain the fingers. What is called the culm of Wales by Mr. Kirwan, and which he regards as a variety of this Swansea coal. species, is probably the Swansea coal, of which some kinds have a singular and highly metallic lustre, approaching even to some iron ores of Elba.

STRUCTURE I. ANTHRACITE.

Aspect 1. Compact. From Alliers, Mont Blanc.

From little St. Bernard, accompanied by fine slate with vegetable impressions.

Aspect 2. Laminar. From Regny, near St. Simphorien. Other sites of both kinds are above mentioned; that of Kongsberg, in Norway, mixed with native silver, being among the most interesting.

STRUCTURE II. KIRWANITE.

The chief differences of this structure have been already mentioned. Mr. Kirwan observes, that when fresh broken it frequently appears of a violet colour. Its lustre he estimates at 4, or metallic; while that of anthracite is from 3 to 4 approaching metallic. The fracture is foliated, but the course of the plates variously, confusedly directed, as in some kinds of common coal. Its fragments are often coated with whitish illinitions;

it will not burn till wholly ignited, and then slowly consumes without caking or emitting flame or smoke. The ashes are reddish and few.

Our learned author unaccountably omits the nature of the rock and gangart; nor does he repair the deficiency in his geological essays.

Aspect 1. Kirwanite from Kilkenny.

The same, with the gangart and specimens of the incumbent rocks.

Aspect 2. The Swansea kind also burns very slow, without flame, and yields a strong and lasting mass of heat, with a glowing colour. Swansea is in the county of Glamorgan, South Wales, in a more southern latitude than Kilkenny.

Kirwanite from Swansea.

MODE III. COAL.

Sites.

This useful substance, which may be said to form the gold mines of England, is not only particularly abundant in the British dominions, but widely diffused over many parts of the world. The Netherlands and France seem to follow Great Britain in this mineral wealth; but it also appears in the north of Italy, and various parts of Germany, as Silesia and Hessia*. It has been used in the north of China from time immemorial, and is not unknown in Japan. Its discovery in Australasia would add little to the advantages of a new country abounding in wood. Concerning the coal of Africa, nothing seems to be reported. In the territory of the United States of America, coal is said to abound on both sides of the James river, but particularly in Virginia, and towards the Ohio. In the isle of Cape Breton there is an extensive bed of coal, which is chiefly used for ballast.

Ancient use.

Coal appears to have been anciently known, not only in China, but in other countries. Solinus * evidently indicates the use of coal, when, mentioning the medical waters at Bath, he says they are dedicated to Minerva, "in whose temple the perpetual fire does not leave embers, but is changed into rocky lumps." This pretended miracle was the natural progress of a coal fire, caked into hard cinders, instead of the soft embers of wood. The abundance of coal in the neighbourhood of Bath also favours this supposition. Nay, Theophrastus mentions that the smiths of Greece sometimes used a black stone for their fires, which must have been *coal* †. In England it seems to have been in common use in the twelfth century; but still more early in Flanders.

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* There is a mine of excellent coal in limestone, in the hill of St. Gingoulph, near Geneva, pronounced, as Saussure observes, § 324, St. Gingo, probably the source of a ludicrous oath in England, because the first reformers were educated at Geneva.

Coal forms prodigious strata, generally rather descending than rising; but the hill of St. Gilles, near Liege, may be said to be chiefly composed of coal, of which there are not less than 50 or 60 strata. The deepest mines known, are said to be those of the country of Namur, some of which descend two thousand four hundred feet, or about half a mile. The semidiameter of the globe is about 3500 miles; so that our knowledge, comparatively, would only extend to the outward texture of the paper, of a common globe three feet in diameter.

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* Cap. 25.

† He says it was found in Liguria, as was amber, and also in Elis; and he speaks of its use as common among the smiths. For that of Liguria, see Mode iv. Gagas whence the name of jet, as first found there, was near Chimera, probably a pseudovolcano, arising from inflamed coal.

Soils. Mr. Kirwan has, with his usual accumulated reading, discussed the various soils in which coal appears; but an enumeration of the different beds of clay and stone, would little interest the general reader, while the scientific may consult his work*. The beds which immediately cover coal, and are thence called its *roof*, are shale, (a kind of clay-slate,) and argillaceous sandstone. Both contain impressions of vegetables, generally such gigantic ferns and reeds as at present astonish the traveller in the tropical regions. The strata on which coal reposes, which are thence called *floor*, *sole*, or *pavement*, are sometimes shale, or indurated clay; but more frequently sandstone; and often the red ferruginous kind, which is esteemed most ancient. The shells are chiefly those of rivers, and seldom those of the sea. It is now well known, from the experiments of Mr. Hatchet, that this substance is of vegetable origin; and it is a singularity, but upon which no general theory can be constructed, that the chief beds of coal occur near the mouths of great rivers, and in a kind of proportion to their relative size. Thus the immense Rhine, which seems, like many other powerful streams, to have more than once altered its estuary, has in its vicinity rocks of coal at least 80 feet in thickness; while more moderate strata are found near the Rhone, the Clyde, the Forth, the Tyne, the Severn. In some instances the form of the coal district is that of an isosceles triangle, the vertex being towards the sea. In savage countries, darkened with immense forests, and where wood is only a superfluous weed, the quantity of trees overturned by age, tempests, and inundations, exceeds all imagination. On the Missouri, there is said to be a bridge, not less than three miles in length, formed by successive trunks of trees, which have been stopped in their progress; and the soil near its mouth may be said to be formed of alternate strata of timber and mud, which may probably become coal and shale, for the use of nations to be born, after a period of many thousand years, and who, perhaps, may faintly trace in their annals some memory of a celebrated ancient nation called Britons.

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* Geol. Ess. p. 290.

But this is merely an excursion of theory, and the origin of coal is far from being precisely ascertained. It occurs in such places, and with such circumstances, as, like the other works of nature, seem calculated to confound the faint light and puny pride of human reason.

Patrin's remarks.

Patrin, with his usual ingenuity, enumerates some of the most striking features, which accompany this important formation.

"Many similar circumstances every where accompany beds of coal.

"1. It is known that this deposit must have been made in still water, and that it has been found on the sides of the soil which has served it for base. In general, beds of coal have their extremities even with the ground, they descend obliquely; they assume in their depth nearly a horizontal position, afterwards to ascend on the opposite side; so that by taking away, in idea, all the soil which covers them, they will be found to have nearly the form of a boat: it has been remarked also, that they are thicker at their depth than at their ends.

"This disposition is manifest in a great number of mines, and especially in the vast coal mines in the neighbourhood of Liege.

"2. A bed of coal is never single: at Whitehaven in England there are 20, one above another; at Liege there are reckoned 60*; three or four are most commonly found, and in general of nearly an equal thickness.

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* At Gilmerton, near Edinburgh, there is the same number. Williams, i. 41.

“ 3. Each bed of coal is separated from the others by several rocky strata, which are nearly the same in all coal mines.

“ Those which form the roof and the wall, are always of a schistose argillaceous substance, a kind of friable schistus, almost always sulphureous: afterwards follow strata of micaceous sandstone, which seem derived, at least in part, from the *detritus* of the primitive mountains of the neighbourhood.

“ These strata of sandstone are often separated by small schistose layers, which contain some symptoms of coal; they are both often repeated between two beds of coal.

“ It is a general observation, and almost without exception, that the schistose layers, and especially those which serve as a roof to the coal, bear impressions of vegetables, particularly *capillaria*, ferns and reeds, for the most part exotic. This circumstance has led several naturalists to think, that coal itself is composed of the remains of vegetables; but this opinion appears to me to present great difficulties[*].”[†]

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[*] “ One of the facts, which is most opposite to it, is the observation made at Santa-Fe-de-Bogota, by the naturalist le Blond, who

[†] Patrin, Min. v. 317.

Some select observations concerning coal may be added from various authors.

By Mr. Kirwan's experiments coal commonly consists of about 60 carbon and 40 bitumen*.

Structure.

Though coal has never been found crystallised, it seems to split into regular cubes; and another singularity in its structure has recently been observed, that between the layers of a bright bituminous appearance there are thin plates of a velvety lustre, bearing a strict resemblance to charcoal. Coal sometimes contains in little cavities, crystals of calcareous spar, perhaps infiltrated from incumbent limestone. These crystals, towards their summits, present little black zones, arising from the coaly impregnation. Galena, or sulphate of lead, is also found in the coal of Buckinghamshire. Pyrites are common in most kinds of coal; and, perhaps, the beautiful iridescent illinitions, which in some rare in-

Metals, &c. in coal.

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informs us that beds of coal are there found at an elevation of 13,200 feet perpendicular. When the ocean reached such a height, there would be above its level but a small number of islands scattered over the face of the globe; and it is not any how seen, how the small quantity of vegetables, which had been accidentally brought from these summits of mountains, into this immense ocean, could have formed the thinnest bed of coal, or even of simple turf."—Is not this coal of Santa-Fe anthracite?

* Bitumen long retains its properties. That found on the bricks of Babylon, where it was used as a mortar or cement, still burns, as Mr. Parkinson observed, with a strong bituminous scent.

stances equal all the colours of the richest gems, may arise from the iron and sulphur, as they greatly resemble those of the beautiful ores of Elba.

Oxyd of copper has also been found in coal at Schemnitz in Saxony; cinnabar in that of Idria; native silver in that of Hessia; nay, gold decorates the coal of Reichenstein in Silesia. It is also said that antimony is found in that of the isle called Bras d'or, near Cape Breton in America [*].

Werner's arrangement.

Werner has arranged one species of coal under his genus graphite, namely the glance coal; which he again subdivides into the conchoidal and the slaty. *Glance*, applied in the German sense to some ores, and a kind of coal, implies that they have a peculiar bright lustre; and his glance coal with the colour of tempered steel, or a bright variable blue, and which burns without flame or smell, is the same with that found at Swansea, here arranged as a structure of anthracite; for it has neither the appearance nor chemical character of graphite. The slaty glance coal of Werner, the *kohlenblend*, or coalblend of other German mineralogists, is the anthracite. To such inconsistencies have the forced and unnatural application of genus and species, to inert matter, reduced even the ablest authors.

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[*] Brongniart, ii. 10.

Of common coal, Werner numbers two species, the *black*, and the *brown*.

Black coal.

The *black* coal contains six subspecies; 1. Pitch coal; 2. Columnar coal; 3. Slaty coal; 4. Cannel coal; 5. Foliated coal; and 6. Coarse coal. The first is *jet* which belongs to lithology; the second which burns without flame or smell, is an anthracite, as Voigt allows, and is merely a rare variety. But from the want of judgement in distinguishing between the grand and important substances, and those which are merely trifling and rare varieties, sometimes only exceptions or excrescences, the very arrangement of mineralogic systems is often the source of unnecessary embarrassment; the separation of the pretended species being sometimes radical and essential, and often of the most trifling and ambiguous nature; nay, sometimes as ridiculous as if the species of trees were to be estimated by the mosses which grow upon them, the fantastic forms occasioned by accident, or the cavities hollowed by the hand of time.

The third *subspecies*, which in this barbarous system follows jet, a rare and precious substance, and columnar coal which is confined to one hill, the Meissner in Hessia, is that called *slate* *coal*, which is that substance universally known by the sole name of COAL, which is diffused in vast exuberance through half the globe, and supplies nations with necessary fuel and opulent manufactures! This instance of want of judgement may be added to numerous others already observed by Mr. Chenevix *.

The fourth *subspecies* of Werner is *cannel coal*, so called from the enunciation of the word *candle*, in Scotland and the north of England, because its flame is clear and pure, like that of a candle. By many French writers, and even by Brochant and Brongniart, it has been strangely confounded with *Kilkenny coal*, which being an anthracite emits no flame; a clear distinction, indicated by the simplest chemistry of nature. It is not only found in several coal mines of the north of England, but in those of Gilmerton near Edinburgh. When very pure, it is made into various little vessels, snuff-boxes, and ink-holders. The Roman writers mention jet, as a chief mineral product of Britain, and some suppose that the cannel coal is intended, but it would rather appear to be the real jet found on the eastern coasts, particularly that of Norfolk, and which, as the substance is merely bituminous wood, may either proceed from parts of the submarine forest, recently observed on the coast of Lincolnshire: or, as it is very light, may be brought by the sea from a great distance.

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* See his Critique on the Wernerian system, in the *Annales de Chimie*, 1809.

The fifth *subspecies*, the *foliated* or *laminar*, is found in the Electorate of Saxony, and in Silesia; but it may certainly be observed in almost every coal pit, as in fact almost all coal may be said to be slaty; nay, Werner has arranged it himself under that subdivision. The last, and very important *subspecies*, is *coarse coal*, which, forsooth, has been found in the coal works near Dresden! It is too well known to many of my readers, and rather too abundant on the London wharfs. By such sagacious subdivisions, an impure gold must be regarded as a different metal.

Brown coal.

It may, perhaps, be satisfactory to complete this brief view of Werner's coal, which, like the magical mirror of Dr. Dee, formed of cannel coal, represents spirits and species of all kinds and dimensions, with some account of his other division, that of *brown coal*, which contains five *subspecies*. 1. Bituminous wood; 2. Earth coal; 3. Alum earth; 4. Common brown coal; and 5. Moor coal.

The *first* is an important and widely diffused substance which may be said to form rocks, or rather mountain masses, by the Germans called *Bergarts*; for as rocks may be formed of shells and other animal substances, so they may be constituted of the venerable remains of primeval vegetation. This kind is the *Bovey coal* of England; and in the Prussian amber mines is found with adhering amber. It is the *Surturbrand* of Iceland where it abounds; and is diffused through many parts of Germany, France, Russia, Siberia, and other grand regions of the world.

The *second* subspecies, *earth coal*, is sometimes found with the former, being merely bituminous wood more decomposed. The *third*, or *alum earth* is certainly a most capricious alteration, as he had formerly and properly arranged it among the argils, and it ought in lithology to stand at the very head of that class. It may have been used as a fuel, as orsten is in Ireland; and, perhaps, Mr. Werner may, in his annual almanack of classification, arrange that limestone among the coals. The fourth subspecies, *common brown coal*, is, by Mr. Jameson's own account, the same with the first or bituminous wood, being found at Bovey, and in Prussia, with amber; so that it can hardly be called a variety, certainly not a diversity. The *fifth*, or last *subspecies*, that of *Moor coal*, is again a mere variety of bituminous wood, but more brittle, as it is mingled with reeds.

The author must confess, that when he had perused Werner's account of the coals, his ideas of the subject were far more confused than ever they were before; so that he seemed with great study to have learned ignorance. This effect must necessarily arise, when subjects of the utmost importance, and of the most trifling minuteness, are presented to the mental eye, as of equal magnitude. By the unhappy microscope of external characters, an insect may appear like an elephant; while common sense and chemistry can alone present the objects as they really are. It is the chief, if not the only, use of systems in natural history, to assist the memory; and for this purpose, that the faculty may not be strained and overpowered, it is the office of a judicious arrangement, to present the chief objects in the fore-ground, while the others are marked at gradual distances, that the mental eye may repose, as upon a landscape, painted by a master artist.

Soils.

But to return to a more immediate view of the subject. It is not a little remarkable that different qualities of coal are found in different strata of dissimilar rocks, thus confirming an observation already made, that the quality of mineral substances is often influenced by their gangarts. Mr. Kirwan has observed, and he has illustrated the observation by many examples, that the soils containing coal are chiefly clay and sandstone, often both together; which are followed by the rarer instances of coal found under trap or basaltin, which may also assume the form of amygdalite; or, by the coarseness of the particles, become a basalton or grunstein. Thick beds of coal have also been found amid the strata of limestone. As the theme is of great importance to national and individual wealth and prosperity, it may be proper to subjoin the brief general view by Brongniart.

" The coal regions follow in general the same order of composition. 1. Psammites (micaceous and ferruginous sandstone, with a cement generally of argil,) often large grained: they are not only composed of quartz and mica, but of fragments of all kinds of rocks, particularly of felspar. 2. Argillaceous and micaceous schisti; presenting on their plates impressions of fishes and vegetables, which generally belong to the families of ferns and grasses. 3. Beds of marl, carbonated lime, or indurated clay. 4. A kind of secondary argillaceous porphyry, which contains branches, roots, and even entire petrified trees. 5. Argillaceous iron ore. 6. Rolled pebbles enveloped in ferruginous sand."* He afterwards observes, that the limestone which contains coal, often becomes black from inhalations of the bitumen, while the inherent shells are of a white colour.

Slips or dykes.

A remarkable circumstance in coal mines is the frequent occurrence of what our miners call *slips* or *dykes*, while the French call them *creins* or *failles*, consisting of indurated clay, basaltin, called *whin* in Scotland, and sometimes of sandstone. These are sometimes of great extent, and a whin-dyke is said to pass across the estuary of the Forth, from East Lothian to Fife, a distance of 10 or 12 miles. These slips intersect the strata of coal, almost at right angles; and generally derange them, in regard to elevation, the stratum of coal being higher and lower on the different sides of this interruption. It seems a general observation that the strata always sink, on what may be called the back of the slip, which seems to indicate that the matter was ejected from beneath, and that the consequent cavity had occasioned the subsidence on that side. These slips sometimes contain fragments of coal †. They appear in the section of the noted hill of St. Gilles, near Liege. Gennetè has inferred that there are in this hill not less than 61 beds of coal which are salient, or in the mining language *rise to the day*, at distinct distances, but only 23 are worked. The coal mines of Anzin, near Valenciennes, described by Daubuisson, present singular large zigzags which seem to defy all theory, except the prodigious power of steam, arising from internal fires and waters, and acting while the beds were yet soft.

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* Min. ii. 6.

† Near the slips the quality of the coal changes; it sometimes becomes iridescent; still nearer it splits and is friable; then be-

Coal mines of England.

The limits and nature of tl
mit a description of the im r
even of England. Those of
most celebrated, as they have sup
tal for many ages. The land which
mineral treasures, is often fertile,
argillaceous sandstone, which f
grindstones, not only common
exported to other countries. Even
grand monuments of human indu r,
veller being astonished to see large
with coal, proceeding without h
on wheels adapted to wooden ways
with iron. The coal mines of Whit
the western coast, are the more remarl

---

comes dull, earthy, and, as it were, identified with the dip. J
Mines, No. 13, p. 59.

they are continued for a space of more than 1200 yards, or two thirds of a mile under the sea; a situation like that of a mine in Cornwall, where the raging waves are heard over head, most terrible to the imagination. The most celebrated coal mines of France are those of St. Etienne, in the department of the Loire, which have been worked for many centuries. Those of Flanders are also of ancient reputation: and, perhaps, our attention to this valuable substance was, like many other useful improvements, derived from our commerce with the Flemings *.

Even in the same bed the coal is seldom of the same quality, or homogenous; so that many of the German subdivisions would, in the case of any other substance, be regarded as mere varieties. Such is the fibrous coal of Estner, which was brought from Newcastle; the ribbon coal of Irvin on the western coast of Scotland; the parrot coal, said by some to be so called from its iridescence, while others suppose that it received its name from the crackling noise it makes when first kindled. It is surprising that Werner has not arranged the earthy coal, called *smut* or *culm*, as a distinct subspecies. It has been observed, that where the coal approaches the slip, it has lost its bitumen, whence it is argued, that the slip rose heated from beneath; while others only infer, that the bitumen has been absorbed by the humid rock. In confirmation of the former opinion, it is added, that in the north of Ireland the layers of flint become red and light when they approach the whindyke; and specimens which I have seen, certainly bore every mark of having been affected by great heat.

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* According to Buffon, Min. i. 478, 4to. the deepest coal mines are those of Namur, 2,400 feet.

Iridescent. The iridescence of coal often penetrates a large mass, and appears in almost every direction. In the peacock coal of Wales or Somersetshire, this iridescence often assumes a strong resemblance of what are called the eyes in a peacock's tail*. In that of the valley of Llangolen, the iridescence consists of steel-purple, crimson, green, yellow, and blue, disposed in zones. But by far the most beautiful of this kind, is a coal found in small portions, near Valenciennes, in which crimson, green, blue, and yellow, perfectly opalise or interchange; so that the substance has more splendour than even the noble opal. The exquisite vivacity of the tints can only be equalled by some of the celebrated iron ores of Elba;

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* Mr. Parkinson, Org. Rem. vol. i., informs us that peacock coal is found in Somersetshire at a considerable depth, the surface being mingled with fossil shells, and vestiges of fern.

nd probably, on a chemical analysis, these
inds of coal would be found to yield a small
ortion of iron and sulphur.

The structure of coal, as already mentioned,
ay be regarded as universally schistose: and it
believed that even the columnar may be con-
idered on a large scale, in the same point of
iew, that is, the columns are horizontal, and
iled like billets of wood on each other. The
mall columnar kind found in Scotland, consists
f little columns, about half an inch in diame-
er, and a few inches in length, united in a com-
on base [*]. Its form seems to arise from the
erruginous gangart, which envelopes, as in a
heath, the little columns of coal; and it is like-
ise said to occur in a form merely schistose.
t is in fact so minute as rather to belong to li-
hology. The chief variations of coal can there-
ore only be classed as aspects.

Aspect 1. Common coal. This substance is
nly observable when it presents some remarkable
iversities, is accompanied with singular accidents,
r is brought from new regions.

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[*] Mr. Jameson, Dumf. 160, says it is found about four miles
rom New Cumnock, Ayrshire, along with graphite, which is also
ometimes columnar.

Coal from Australasia.
The same from China.
The same from Cape Breton.
Ribbon coal, from Irvine, Scotland.
Peacock coal, from Wales, or Somersetshire.
Opaline coal, from Valenciennes.
Coal with calcareous spar, from Derbyshire.
With lead, from Buckinghamshire.
With foliated pyrites, and white veins of calcareous spar, from Derbyshire, &c.
With antimony, from North America.
With cinnabar, from Idria.
With copper ore, from Saxony.
With native silver, from Hessia.
With gold, from Silesia.

Aspect 2. Laminar or *Foliated.*

From Saxony and Silesia.

From the mines of Wodensbury, or Whisbury, in Staffordshire. It is commonly of inferior quality.

Aspect 3. Cannel coal. This occurs in more thick and compact layers, and the fracture is sometimes even, sometimes large and flat conchoidal.

Cannel coal, from Lancashire and Shropshire.

The same, from Gilmerton and Muirkirk, in Scotland.

Aspect 4. Columnar coal.

As the German kind belongs to anthracite, so it is probable that the Scotish is of the same description; the latter, however, presents the velvety appearance of the charcoal plates in common coal; but is so deeply impregnated with oxyd of iron, that it is partly of a brown, partly of a metallic lustre; which may not only be the cause that it does not flame, but is probably the original source of its columnar form, which iron often affects; and as the power and predominance of that metal are very great, it often manifests its presence, by inducing almost any other substance to assume its tendencies.

MODE IV. LIGNITE.

This name has been assigned, with great propriety, by Brongniart to the substance which Werner has called *brown coal*, with his usual attachment to colours, which of all denominations are the most vague and illusory. Some who prefer Greek etymons might call it *xylite*, derived, in like manner, from *wood;* but the Latin language is equally classical with the Greek, and Name.

is of general use in the definitions of natural history; so that there seems no reason for its exclusion, while on the contrary its admission affords a pleasing variety.

The account of lignite, given by Brongniart, is so complete, clear, and satisfactory, that it shall be translated with a few subjoined observations; after premising that one of his varieties, namely jet, rather belongs to lithology in every sense, as it is found in small pieces, and only applied to minute purposes of use or decoration.

The others are found in large beds or masses, by the Germans called *bergarts;* and though many rocks are composed of shells, corals, madrepores, and other animal remains, the reader might be startled at the idea of a rock composed of wood. Yet rock-salt, which will be treated among the Anomalous, perhaps affords an idea little less incongruous; and too great precision would lead to neology, which ought always to be avoided, except in cases of indispensable necessity. Rocks of pumice or of obsidian, or even of topaz, are ideas equally new to the generality of readers, yet they exist in nature, which must be followed, and not controlled.

Brongniart's account.

"The combustible minerals which belong to this species, are characterised by the odour, and the products of their combustion. The odour they spread in burning, is pungent, often fetid, and has no analogy with that of coal or bitumens. They burn with a clear flame, without bubbling or caking like coal, or running like solid bitumens. They leave powdery ashes like those of wood, but often in greater quantity, more ferruginous, and more earthy: they seem to contain a little potash *. These combustibles give an acid by distillation, which coal does not.

" Lignites vary in colour from deep and shining black, to an earthy brown: the texture of the greater part of the varieties indicates their origin, and gives rise to their name. The woody tissue is often observed, though sometimes it has wholly disappeared. The fracture of lignite is compact, often resiniform and conchoidal, or shining and straight.

" The external characters of the varieties of the species differ too much among themselves, to allow them to be farther generalised.

" 1. *Lignite jet* †. It is hard, solid, compact, and capable of receiving a very bright polish; it is opake and of a pure black; its fracture is undulated, and sometimes shining like that of

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" * M. Mojon found about 3 in 100 in the ashes of the bituminous wood of Castelnuovo.

" † Jet, Haüy.—*Pechkohle, piciform coal. Broch.*"

pitch. Its specific gravity is 1,259. It is said to be sometimes lighter than water*.

“ This variety is found in layers of little thickness, in marly, schistose, calcareous, or sandy beds. The organic tissue of wood is sometimes observed in it.

“ This lignite is found in France; in Provence; at Belestat, in the Pyrenees; in the department of the Aude†, near the village of Bains, six leagues to the south of Carcassone; this sometimes contains amber; and near Quilian, in the same department, in the communes of Ste. Colombe, Peyrat and Bastide; it is at the depth of 10 or 12 yards, in oblique layers, between beds of sandstone; but these layers are neither pure nor continuous. Jet, proper to be worked, is found in masses, the weight of which seldom exceeds 50 pounds. These mines have been wrought for a long time, and have produced a considerable quantity of jet, which is cut and polished in the same country.

“ In Germany, near Wittemberg in Saxony; it is also there wrought and polished. Very fine jet has been found in Spain, in Galicia, and

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“ * I doubt if real jet be ever lighter than water. This property seems rather to belong to the next variety.”

† An account of the manufacture of jet, in the department of the Aude, may be found in the Jour. des Mines, No. 4, p. 35—8.

in the Asturias. In short, it is mentioned as occurring in Iceland, in the western part of that isle.

"Of this combustible, ornaments are made, particularly mourning trinkets. Jet is polished with water, on a wheel of sandstone, worked horizontally. Jet, mingled with pyrites, is generally rejected.

"2. *Friable lignite**. This variety is found in extensive and thick beds; it is of a bright black, but less bright than the preceding kind; what above all distinguishes it, is its great friability; its surface is always cracked, and its masses are divided, with the greatest facility, into a number of cubic pieces, a character which lignite jet does not present. In some instances, the tissue of vegetables, which have formed it, is observable.

"Friable lignite is more abundant, and consequently more useful than the two first varieties. It is found in horizontal beds, often thick and extensive, but is never found in such large masses as coal, with which it has very improperly been confounded. It not only differs by its properties, but it also differs in its locality. It is found in masses of sand, which often fill calca-

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"* *Moorkohle, mud coal. Broch.*"

reous valleys, or which lean against the hills which skirt them. It is also found, but more rarely, in argillaceous marl.

" This combustible is common enough in the south of France, particularly in the department of Vaucluse. I have found it under the circumstances I have just mentioned, at Piolin, near Orange.

" It is found in very large mass, at Ruette, department of the Forests.

" It easily burns, but emits a very disagreeable odour. It can only be used in manufactures, and to burn lime. Smiths cannot use it in their forges.

" 3. *Fibrous lignite* *. Its colour varies from a clear blackish brown to a clove brown. It has a perfect woody form and texture, consequently its longitudinal fracture is fibrous, and in its transverse fracture are perceived the annual circles of the wood.

" It is easier to break than wood; under the knife it assumes a kind of lustre.

" This lignite is sometimes found in considerable masses.

" It is found in France, in the neighbourhood of Paris, near St. Germain, in the isle of Chatou,

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" * *Gemeiner-bituminoses-holz*, common bituminous wood—Wern."

which seems to be entirely formed of it; and near Vitry, on the banks of the Seine, there is a thick bed of trunks of trees well preserved (Gillet Laumont). In the department of Ariège, the clefts of this lignite are penetrated with sparry carbonate of lime. In Liguria, near Castel-Nuovo, at the mouth of the Magra, it is in thick and very extensive beds. In Hessia, near the mountain of Ahlberg, the layer is two yards thick. In Steinberg, near Munden in Hanover, it forms two layers, one 10 yards, and the other six, which are separated by a bed of rock from 12 to 14 inches thick. In England, at Bovey near Exeter, there are 17 thick beds, which are at a depth of about 66 feet, under sand, and in potters clay. In Iceland it is very abundant, and is called *surturbrand;* the trunks which form these heaps are very distinct, and seem merely to have been compressed.

" But this lignite is still more common in little detached masses; sometimes it accompanies the preceding varieties; sometimes it is found alone, in small layers, in the midst of beds of argil or of sand. It is met with almost every where, and is used as fuel in those places where it is abundant.

" This vegetable, rather than mineral combustible, being scarcely decomposed, would not deserve to form a variety in the systems of minerals, if it did not pass by imperceptible degrees to the varieties which precede it, and to that which follows. Its history, in strict language, more properly belonging to geology, than to mineralogy.

" *Earthy lignite* *. This substance is black, or of a blackish brown, mingled with a reddish cast. Its fracture and aspect earthy, fine grained, rather soft, even friable, smooth to the feel, and becomes bright by scraping. It is nearly as light as water. It burns, emitting a disagreeable smell.

" It not only often contains remains of vegetables, but sometimes itself presents the texture of wood, without ever possessing either the colour or brightness, or the hardness of the preceding varieties.

" Earthy lignite, burns sufficiently free to be used as fuel; it gives a gentle and equal heat, but exhales an odour generally unpleasant, but sometimes rather agreeable.

" It is found sometimes in the midst of secon-

" * *Bituminose holzerde*, earthy bituminous wood. Broch. Vulgarly earth of *Cologne*, and sometimes, but improperly [illegible] Umber, properly so called, which comes from Italy, or the East, containing nothing that is combustible, cannot belong to this species."

dary earths in the neighbourhood of coal mines; sometimes, and even most often, in alluvial land.

"We shall mention, as an authentic example of this variety, the earthy lignite of the environs of Cologne, known in trade by the name of earth of Cologne, as it is wrought at a little distance from that city, near the villages of Bruhl and Liblar. This lignite forms very extensive beds of eight or ten yards in thickness, which are situated under considerable elevations. It is immediately covered with a bed, more or less thick, of rolled pebbles of quartz and jasper, as large as eggs, and reposes on a bed of white argil, of an unknown thickness. The bed of lignite is homogenous; but fossil vegetables are found in it, very well preserved. They are, 1. Trunks of trees, lying one on the other, without any order, the wood being black or reddish, generally compressed: they easily exfoliate, by drying in the open air. Some belong to trees of the dicotyledon kind, others are fragments of palm-trees. Among these, M. Coquebert-Montbret has found some which are full of small round pyritic bodies, resembling grains of small shot *. This wood

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"* M. Heim has remarked in the lignite of Kalten-nordheim, in Thuringia, small elongated spherical substances, resembling a pod of two partitions. M. Blumenbach supposes them to be unilocular bivalve capsules. (*Journal des Mines*, No. 105.)"

burns very well, and even with a kind of flame. 2. Woody fruits, the size of a nut, and which have been known to be those of a species of the palmtree *(areca)*. The lignite of Cologne contains about 0,20 of ashes, rather alcaline and ferruginous (Ant. L. Brongniart.) Its uses are various; it is worked in open air with a simple spade; but the more easily to transport it, it is wetted, and moulded in vases, which give it the form of a truncated cone.

" It is used as fuel in the environs of Cologne. It burns slowly but easily, and without flame, like tinder, giving a lively heat, and leaving very fine ashes. These ashes being considered as a very good manure, to obtain them a part of this lignite is burnt on the spot where it is wrought.

" Earth of Cologne is more especially used for painting in distemper, and even in oil colours. The Dutch use it to adulterate their snuff; when it is not mixed in too great a quantity it gives the snuff a fineness and softness, which is much esteemed, and cannot be in the least injurious. (Faujas.)

" This lignite is also said to be found in Hessia, Bohemia, Saxony, Iceland, &c. (Brochant); but as there has been a confusion between this combustible and the variety of ochre, called *umber*, we cannot be positive that these local indications have really any relation to earthy lignite.

"It may have been observed, from what has been just said on the situations peculiar to some varieties of lignites, that this fossil combustible belongs to soils of the most recent formation, since it is only found in accretions of sand or argil. It is almost never met with under rocky beds, except in coarse carbonated lime, and under basalt. In the mountain of Ringe Kuhle in Hessia, several thick layers of lignite are observed, lying on a sandstone, and separated by layers of potter's clay and sand (Mohs). On the sea shore, near Calais, fragments of lignite have been picked up, which were penetrated with crystals of quartz, very limpid, and disposed in spheres.

"Lignite then is of a very different formation from that of coal; and M. Voigt thinks that there is no transition between those two combustibles.

"The air which circulates where lignite is wrought is generally bad*."

In his Essay on Geology, Faujas has given an accurate and ingenious account of the prodigious mass of lignite near Cologne, which extends Of Cologne.

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* Brongn. ii. 3Q.

for many leagues, and is covered with a bed of pebbles from 12 to 20 feet in thickness, while the lignite itself exceeds 50 feet[*]. Our ingenious observer says that the trunks of trees, which are often found, are always deprived of their branches; whence he argues, that they have been conveyed by the ocean. Besides the nuts, which now belong to Hindostan, the Moluccas, and China, masses of a kind of gum or frankincense are found, which when burnt perfume the huts of the peasants[†].

Masses of a similar kind have been found in many quarters of the department of the Aisne; one of the most remarkable being that near Beaurieux, where a pit sunk to the depth of 65 feet, ended in a subterranean marsh, full of sand and water, which soon filled the pit[‡]. In that of Villers-en-Prayer, at the depth of 17 or 18 feet, a lignite was found much impregnated with pyrites, as are most others of the Aisne. In this bed of decomposed wood, which is about three feet six inches in thickness, are found pieces of fossile wood, partly carbonised; some bones of animals, seemingly of wild kine; amber in round or angular fragments, some quite transparent and sometimes imbedded in pyrites. Such venerable relics must not be confounded with peat, which commonly proceeds from the decomposition of graminous and other small vegetables, though trunks, hazel nuts, &c. be occasionally found. Faujas supposes with Patrin, that coal itself may often consist of wood brought by the sea, and deposited in recesses at considerable elevations, when the globe was studded with primeval islands. The numerous sea plants, molusks, and oily carcases of so many fish that daily perish, also contribute, in his opinion, to this product; but this theory has many difficulties.

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[*] i. 410.

[†] There is in Prussia a mine of amber, 98 feet deep, and the amber is found between two salbands of lignite, and sometimes adherent. Jour. de Phys. tome xxxix, p. 365. At Vorospatac, in Transylvania, a lignite is found with leaves of gold. Journ. des Mines, No. 23, p. 83.

[‡] In Mount Meisner, Hessia, there is a very thick bed of fossil turf, with trunks, branches, and roots of trees, reposing on limestone, and covered with basalt. De Luc, Geol. 339, thinks that such hills had sunk under water, and were again elevated. At Schemnitz there is a vein of lignite at the depth of 360 yards. Journ. des Mines, iv. 807.

Professor Hollman of Gottingen, published in 1784 an account, which had before appeared in the Philosophical Transactions, vol. 51, of some hills or mountains, as he calls them, near the city of Munden, and in that point of land which is washed at their junction by the rivers Werra and Fulda; one is about 1150 feet in height, and they may be said almost to consist of fossile wood. Another near Altendorf, on the borders of Hessia, about 1800 feet in height, presents vast quantities of fossile wood, under a stratum of stone, not less than from 80 to 140 yards in thickness[*].

Bovey coal.

One of the most remarkable lignites is the Bovey coal of England, already mentioned. Dr. Kidd observes, that it is attended with a kind of porcelain clay, derived from the waste of the adjoining granite hills, subsiding into this heath, which is a natural basin[†]. The sandy quartz, and fragments of felspar, correspond with those of the adjacent granite. This lignite often rises in the form of trees, but is often compressed in straight flat pieces, three or four feet in length, which are called *board-coal*, from a natural resemblance; an observation which may also be extended to the *surturbrand* of Iceland. Mr. Hatchet has, with his usual acuteness and ability, examined many similar substances, as the wood of the submarine forest, off Sutton, on the coast of Lincolnshire, which he found yielded kali, and had no character of coal. An analysis of 200 grains of Bovey coal yielded water 60, thick brown oily bitumen 21, charcoal 90, mixed gaz 29.

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[*] Parkinson, Org. Rem. vol. i. He supposes tl passes through a bituminous fermentation, after wh it is with water full of siliceous particles. See also ii. w adds, that animal matter, by long residence in water, was verted into the *adipocere* of Fourcroy, resembling spermaceti. ingenious writer has also observed, i. 364, the presence and fluence of bituminous matter in the semi-opal, and other waxy lustre; so it may enter into the opal. But as Kl found inflammable matter, may not the carbon, which proportion of bitumen, here exert its power?

[*] Outlines, i. 166.

Origin.

The presence of the substances, called by the chemists *extract*, *resin*, and *fibre*, are esteemed to evince the original vegetable character, however it may be transmuted or disguised. The excellent experiments of Mr. Hatchet, demonstrate that the *extract* is the first principle that disappears, next the *resin*, and lastly the *fibre*. When every mark of organisation has thus disappeared, the substance becomes compact, and the conchoidal fragments resemble pitch *. In this new condition it is called coal, to which the lignite of Bovey nearly approximates. In the strata of this substance, Mr. Hatchet also observed small masses approaching to the nature of the lignite of Cologne, and which he called *resinasphaltum*, or resinasphalt, as it contains about 55 of resin, and 41 of asphalt.

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* Ib. ii. 42.

STRUCTURE I. FIBROUS.

Aspect 1. Entire. Bovey coal.

Surturbrand, from Iceland.

Fibrous lignite, from France, Liguria, &c.

Aspect 2. Mingled. Bovey coal, with resinasphalt.

Lignite, with amber, from Prussia.

STRUCTURE II. FRIABLE.

From the south of France.

STRUCTURE III. EARTHY.

Aspect 1. Entire. Ui
logne.

Aspect 2. Mingled. The same, w
sembling the areca.

With a gum which burns like frankincense.

Having thus described the ESSENTIAL ROCKS,
or those which receive their divisions and
minations from preponderant or from pred
nant substances, whence they might

l SUBSTANTIAL ; it now remains to attempt
ır classification and description of the AC-
NTIAL, or those which must necessarily be
ged according to attendant accidents and
mstances.

END OF THE FIRST VOLUME.

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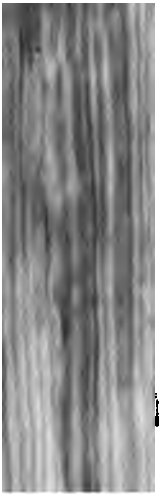

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